Children's sleep behaviour and chronotype in context to mothers' sleep-wake patterns and distress

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Abstract: Children's sleep behaviour and chronotype in context to mothers' sleep-wake patterns and distress Schlafverhalten und Chronotypus von Schulkindern im Kontext zu Schlafverhalten und subjektiv erlebter Belastung der Mütter Helene Werner Untersuchungsziel: Die Ziele der vorliegenden Dissertation bestanden darin einen Fragebogen zur Erhebung des kindlichen Chronotypus zu entwickeln und zu validieren, Daten bezüglich der Übereinstimmung/Nicht-Übereinstimmung der in der klinischen Praxis am häufigsten eingesetzten Untersuchungsmethoden (Fragebogen, Protokoll, Aktimetrie) zur Bestimmung des Schlaf/Wach-Rhythmus des Kindes zu bestimmen und Unterschiede wie auch Assoziationen zwischen kindlichem und mütterlichem Schlafverhalten (Schlafdauer, Chronotypus, Nacht-zu-Nacht-Variabilität) zu eruieren und der Frage nachzugehen, inwiefern Unterschiede im Schlafverhalten zwischen Kindern und Müttern wie auch elterliche Erwartungen an das Schlafverhalten der Kinder mit der subjektiv erlebten Belastung der Mütter in Beziehung stehen. Studiendesign: Querschnittsstudie mit gesunden präpubertären Kindern zwischen 4 und 11 Jahren und deren Müttern. Untersuchungsinstrumente: Quantitative und qualitative Aspekte des Schlafverhaltens wurden beim Kind wie auch bei der Mutter mittels Fragebogen, Schlafprotokoll und Aktimetrie bestimmt. Zur Erhebung des Chronotypus bei den Kindern wurde der selbst entwickelte und validierte CCTQ Children's Chronotype Questionnaire, bei den Müttern der MCTQ Munich Chronotype Questionnaire eingesetzt. Die pubertäre Entwicklung der Kinder wurde mittels Self-Administered Rating Scale for Pubertal Development und die subjektiv erlebte elterliche Belastung mittels Parenting Stress Index PSI-SF erhoben. Wichtigste Ergebnisse: Die drei Chronotypus Masse, die der CCTQ umfasst [Mid Sleep Point an freien Tagen (MSF), Morningness/Eveningness Score (M/E), Chronotype Score (CT)], korrelieren untereinander wie auch mit verschiedenen Schlaf/Wach-Variablen moderat bis hoch und weisen eine exzellente Test-Retest-Reliabilität auf. Die ‚Limits of Agreement' nach Bland und Altman (1986, 1999) zeigen, dass die Aktimetrie und das Schlafprotokoll für Schlafbeginn, Schlafende, Schlafdauer und Mid Sleep Point austauschbar eingesetzt werden können, jedoch nicht für Informationen bezüglich des nächtlichen Erwachens. Die ‚Limits of Agreement' zwischen Schlafprotokoll und Fragebogen wie auch zwischen Aktimetrie und Fragebogen waren ungenügend. Sie können demnach für keine der untersuchten Variablen austauschbar eingesetzt werden. Quantitative und qualitative Schlafparameter unterscheiden sich signifikant zwischen Kindern und Müttern, mit spezifischen Unterschieden zwischen geregelten und freien Tagen. Bettzeit, Aufstehzeit und Mid Sleep Point von Kindern und Müttern korrelieren signifikant zwischen Kindern und Müttern, Schlafqualitätsparameter und die Nacht-zu-Nacht-Variabilität jedoch nicht. Unterschiede im Schlafverhalten zwischen Kindern und Müttern stehen nicht mit der subjektiv erlebten Belastung in Beziehung, wohl aber elterliche Erwartungen an das Schlafverhalten der Kinder. Schlussfolgerungen: Individuelle Unterschiede bezüglich des Chronotypus stehen im Zusammenhang mit spezifischen Gegebenheiten der zircadianen inneren Uhr und psychosozialen Aspekten wie z.B. der Tagesmüdigkeit oder Aufmerksamkeit. Während sehr viel über die Entwicklung, Verteilung und Variabilität des Chronotypus bei Adoleszenten und Erwachsenen bekannt ist, gab es bis anhin kein validiertes Erhebungsinstrument für präpubertäre Kinder (4-11 Jahre). Dies wurde im Rahmen dieser Dissertation erarbeitet wurde und steht nun zur Verfügung. Die Studie liefert wichtige Informationen bezüglich der Austauschbarkeit der in der klinischen Praxis am häufigsten eingesetzten Methoden zur Bestimmung des Schlaf/Wach-Rhythmus des Kindes. Frühere Studien haben

gleichfalls verschiedene methodische Zugänge (Fragebogen, Schlafprotokoll, Aktimetrie) verglichen, aber die Technik nach Bland und Altman (1986, 1999) wurde bis anhin nicht angewendet und adäquate quantitative Aussagen bezüglich der Austauschbarkeit der verschiedenen Methoden („Limits of Agreement“) fehlten. Der Schlaf/Wach-Rhythmus von präpubertären Kindern ist viel mehr als bei älteren Kindern und Adoleszenten in den sozialen Kontext der Familie eingebunden. Die Übereinstimmung/Nichtübereinstimmung zwischen endogenen Faktoren des Kindes (z.B. Schlafdauer, Chronotypus) und exogenen Faktoren (z.B. elterliche Erwartungen an das Schlafverhalten des Kindes) wird als wichtiger Aspekt bezüglich der Entstehung von funktionellen Schlafstörungen betrachtet. Das Wissen über diese Zusammenhänge an einer normativen Stichprobe leistet einen wichtigen Beitrag für das Verständnis von Schlafstörungen und bietet Hilfestellung im Umgang mit schlafgestörten Kindern. This doctoral thesis examines children's sleep behaviour and chronotype in the context to mothers' sleep-wake patterns and distress. The aims were to construct and validate a questionnaire to assess children's sleep phase preference (chronotype), to report agreement rates between the most commonly used methods in basic and clinical sleep research, to assess differences and associations between children's and mothers' sleep-wake patterns, and to explore whether these differences are related to parental distress. Individual differences in chronotype are linked to sleep schedule variability, psychosocial functioning, and specific properties of the circadian clock. While much is known about the development, distribution, and variability of chronotype in adolescents and adults, assessment in prepubertal children has been hindered by the lack of appropriate, reliable and valid measures. The thesis presents a detailed description of the assessment of children's chronotype by the self-developed Children's Chronotype Questionnaire (CCTQ). This instrument uses three different measures for the assessment of chronotype in children between 4 and 11 years of age: the Mid Sleep point on Free days (MSF), the Morningness/Eveningness scale (M/E) score, and a 5-point Chronotype (CT) score. Part 1 of the thesis provides validity data for the CCTQ using actigraphy, as well as 2-4 week test-retest reliability data. Children's sleep-wake patterns can be assessed by different methodological techniques (subjective vs. objective). While previous investigations have primarily focused on infants (see e.g., Sadeh et al., 2004) and adolescents (e.g., Wolfson, 2003) as well as on children's populations with sleep disorders, much less attention has been paid to school-age children and normative healthy populations. Furthermore, previous studies including different methodological approaches have primarily reported reliability estimates, comparisons of mean values, and correlations between methods, which do not provide appropriate information about agreement or disagreement between methods. Part 2 presents agreement rates of the most common used methods in basic and clinical sleep research (questionnaire, diary, actigraphy) by the statistical approach proposed by Bland and Altman (Bland Altman, 1986, 1999) providing normative data for agreement rates in a non-clinical sample of middle-upper class children. Children's sleep-wake regulation is embedded in the family context and must be seen in relation to characteristics of their primary caregivers (e.g., parents' sleep-wake patterns, expectations). Thus, the alignment or misalignment between endogenous (e.g., sleep duration, chronotype) and exogenous components (e.g., parental expectations) may be considered as an important issue for understanding children's sleep disorders. Part 3 of this thesis describes differences and associations between sleep scheduled and quality variables as well as intra- individual variability of these variables of children and their biological mothers assessed by actigraphy. In Part 4 children's and mothers' sleep-wake patterns as well as the differences between children and mothers are studied in relation to mothers' distress measured by the PSI-SF (Abidin, 1995). The findings of Part 1 show moderate to strong agreement between the three chronotype measures measured by the CCTQ, adequate associations between sleep/wake parameters (parent-report and actigraphy) and chronotype measures, and excellent temporal stability for all three chronotype measures (reliability). Limits of agreement according to Bland and Altman (Bland Altman, 1986, 1999) indicate that actigraphy and diary can be interchangeably used for sleep start, sleep end, assumed sleep and mid sleep point, but not for variables related to nocturnal wake time. Agreement rates between diary and questionnaire as well as between the actigraphy and questionnaire were not sufficient. The findings of Part 3 demonstrate significant mean differences between children's and mothers' scheduled and quality variables, with specific differences between weekdays and weekend-days for children and mothers (e.g., sleep duration). Furthermore, there were significant associations between children's and mothers' sleep scheduled variables (e.g., bedtime, get up time, mid sleep point), but no significant associations were found for sleep quality measures (e.g., motionless sleep percentage) and night-to-night variability. The results of Part 4 indicate that mothers' self-rated sleep quality and children's bedtime on scheduled days are related to parental distress while no significant associations were found for mean differences between children and mothers. Parental expectations for children's sleep-wake patterns, defined as soll sleep- wake patterns (what would be in parents' opinion, the soll time for the child to go to bed) were related to children's chronotype and accounted for parental distress. This thesis provides insights into transactional processes between the child and his or her social environment. Knowing differences and associations between children's and mothers' sleep-wake patterns of normal healthy children and their parents as well its relation to parental distress (as an approximation for children's developmental opportunities) play an

important role in understanding children's sleep disorders and can eventually improve the clinical care for sleep problems in children.

Children's sleep behaviour and chronotype in context to mothers' sleep-wake patterns and distress

Thesis presented to the Faculty of Arts of the University of Zurich
for the degree of Doctor of Philosophy

by

Helene Werner
Zurich / ZH

Accepted in the fall semester 2009 on the recommendation of
Prof. Dr. Hans-Joachim Haug and PD Dr. Oskar Jenni

(Zurich, 2009)

Abstract

This doctoral thesis examines children's sleep behaviour and chronotype in the context to mothers' sleep-wake patterns and distress. The aims were to construct and validate a questionnaire to assess children's sleep phase preference (chronotype), to report agreement rates between the most commonly used methods in basic and clinical sleep research, to assess differences and associations between children's and mothers' sleep-wake patterns, and to explore whether these differences are related to parental distress.

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The findings of Part 1 show moderate to strong agreement between the three chronotype measures measured by the CCTQ, adequate associations between sleep/wake parameters (parent-report and actigraphy) and chronotype measures, and excellent temporal stability for all three chronotype measures (reliability). Limits of agreement according to Bland and Altman (Bland & Altman, 1986, 1999) indicate that actigraphy and diary can be interchangeably used for sleep start, sleep end, assumed sleep and mid sleep point, but not for variables related to nocturnal wake time. Agreement rates between diary and questionnaire as well as between the actigraphy and questionnaire were not sufficient. The findings of Part 3 demonstrate significant mean differences between children's and mothers' scheduled and quality variables, with specific differences between weekdays and weekend-days for children and mothers (e.g., sleep duration). Furthermore, there were significant associations between children's and mothers' sleep scheduled variables (e.g., bedtime, get up time, mid sleep point), but no significant associations were found for sleep quality measures (e.g., motionless sleep percentage) and night-to-night variability. The results of Part 4 indicate that mothers' self-rated sleep quality and children's bedtime on scheduled days are related to parental distress while no significant associations were found for mean differences between children and mothers. Parental expectations for children's sleep-wake patterns, defined as *soll* sleep-wake patterns (what would be in parents' opinion, the *soll* time for the child to go to bed) were related to children's chronotype and accounted for parental distress.

This thesis provides insights into transactional processes between the child and his or her social environment. Knowing differences and associations between children's and mothers' sleep-wake patterns of normal healthy children and their parents as well its relation to parental distress (as an approximation for children's developmental opportunities) play an important role in understanding children's sleep disorders and can eventually improve the clinical care for sleep problems in children.

Abbreviations

AC	Actigraphy
BRF	Brainstem Reticular Formation
CBCL	Child Behavior Check List
CCTQ	Children's ChronoType Questionnaire
CNS	Central Nervous System
CT	ChronoType
CSM	Composite Scale for Morningness
DC	Difficult Child
DI	Diary
DR	Dorsal Raphe Nucleus
DSM	Diagnostic and Statistical Manual
EAS	Emotionality Activity Sociability/Shyness Temperament Inventory
ECBI	Eyberg Child Behavior Inventory
EEG	Electroencephalogram
EMG	Electomyogram
FR	Free Days
GABA	Gamma-Amino Butyric Acid
ICD	International Classification of Diseases
ICSD	International Classification of Sleep Disorders
KDQOL-SF-36	Kidney Disease Quality of Life Short Form-36
LC	Locus Coeruleus
LEL	Life Event List
LDT	Laterodorsal Tegmental Nuclei
LH	Lateral Hypothalamus
MCTQ	Munich Chronotype Questionnaire
MEQ	Morningness-Eveningness Questionnaire
M/E	Morningness/Eveningness
MSF	Mid Sleep point on Free days
MSFsc	Mid Sleep Point on Free days, corrected for accumulated sleep deficit
NREM	Non-Rapid Eye Movement
PD	Parental Distress
P-CDI	Parent-Child Dysfunctional Interaction
PPT	Pedunculopontine Tegmental Nuclei

PSG	Polysomnography
PSI-SF	Parental Stress Index-Short Form
QU	Questionnaire
REM	Rapid Eye Movement
SC	Scheduled Days
SCL-90-R	Symptom Check List-90-Revised
SCN	Suprachiasmatic Nucleus
SD	Standard Deviation
SES	Socio Economic Status
SOREMPS	Sleep Onset REM Periods
SWA	Slow Wave Activity
SQ	Sleep Quality
TMN	Tuberomammillary Nucleus
TS	Total Stress
VLPO	Ventrolateral Preoptic Nucleus
ZCSS	Zurich Children's Sleep Study

Table of Content

Tables and Figures

1. Theoretical Background

1.1. Sleep

Sleep is a basic biologic or physiologic need of every human (and animal) individual. Although we do not know why we sleep, there is no doubt that sleep is essential for well-being (Foster & Kreitzman, 2005). In fact, sleep may function as kind of barometer of the individual's physical and mental health (Owens, 2007).

Until now, there are many open-ended questions in sleep research. Why do we sleep? Does sleep concern the entire organism, its nervous system, specific neuronal networks, or just individual synapses? What exactly is sleep? Is it possible to define sleep without its function? Is sleep causally related to learning and memory, and does it promote synaptic plasticity at the cellular level? Is sleep indispensable for cognitive function? Does sleep provide a state in which recovery processes are more efficacious than during wakefulness?

Researchers of different disciplines such as *genetics* (identifying molecular markers of sleep and wakefulness), *cellular physiologists* (describing the neurophysiological and biochemical properties of sleep-promoting factors), *system physiologists* (investigating brain activity in order to unravel the roles of sleep in cognitive functions), and *clinicians such as physicians and psychologists* (assessing abnormal sleep patterns) are involved with their expertise to the open questions. The integration of findings from all these different disciplines is a major challenge, but has promise to provide insights into the contribution of sleep to overall performance and well-being. And finally, patients suffering from sleep and sleep-related disorders may benefit from new knowledge.

1.1.1. Sleep Structure

Sleep is much more than the absence of body and brain activity as it was suggested for centuries. The development of electrophysiological methods (e.g., electroencephalography) and the discovery of rapid eye movement sleep (REM), in the first parts of the 20th century brought evidence that the brain is highly active during sleep (Aserinsky & Kleitman, 1953). Polysomnography (PSG) which is known as the 'gold standard' technique for measuring sleep activity monitors many body functions during sleep including brain activity [recorded by the electroencephalogram (EEG)], eye movements [recorded by the electro-oculogram (EOG)], and muscle activity [recorded by the electomyogram (EMG)]. Sleep consists of two different states [rapid-eye movement sleep (REM) and non-REM sleep (NREM)], and shows a cyclic nature with alternation between NREM and REM sleep. After sleep onset, sleep moves

progressively through the four NREM stages into the first brief episode of REM sleep. In adults, the cycling of NREM and REM sleep lasts approximately 90 minutes. Five of these NREM/REM sleep cycles may be experienced in an average night (Dement & Vaughan, 1999). After the first sleep cycle, NREM and REM sleep continue to alternate in a predictable fashion, although the different cycles are not identical (Figure 1). REM sleep episodes become longer and deep NREM sleep (stages 3 and 4) shorter as the night progresses. The longest REM periods are found in the last third of the night (Carskadon & Dement, 1994). Overall, NREM sleep accounts for 75-80% and REM sleep for 20-25% of the total sleep time (Carskadon & Dement, 1994; Siegel, 2004); although these proportions of REM/NREM sleep vary with age (see Figure 1).

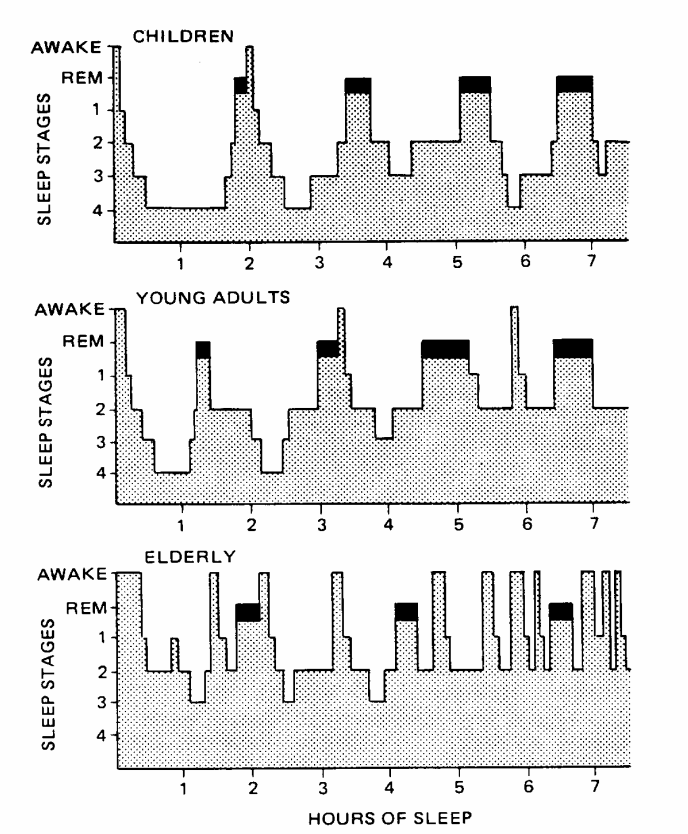

Figure 1. Sleep cycles in children, young adults and elderly (from Kales & Kales, 1974).

1.1.1.1. Age effects on sleep structure

Age is the strongest factor that affects sleep and the distribution of sleep stages through the night. During the first year of life, REM sleep constitutes 50% of total sleep time. The amount of REM sleep decreases to adults' levels of 20-25% by age 3 years and remains more or less constant throughout life (Figure 2). NREM and REM cycles can be observed

already in newborns, but the cycle periods are shorter in the first few months of life than in adults (approximately 50 to 60 minutes; Jenni & Carskadon, 2004). Furthermore, compared to older children and adults, infants enter sleep through REM sleep which changes to sleep onset NREM periods at approximately age 6 months. Sleep onset REM periods (SOREMPS) in older children, adolescents and adults are associated with nocturnal sleep disturbances (for example with narcolepsy; Cornwell & Laxminarayan, 1993).

As already mentioned above, REM sleep occupies a large proportion of time during early human development. Therefore, some researchers have suggested that REM sleep may be important for brain maturation (Mirmiran & Van Someren, 1993; Roffwarg et al., 1966). Roffwarg et al. (1966) for example suggested that the function of REM sleep during development might be a stimulation of the brain in a period when waking life is limited in time and for stimulation. However, the available empirical data do not completely support this hypothesis, which predicts a steady decline of REM sleep, paralleling the decline in total amount of sleep during development.

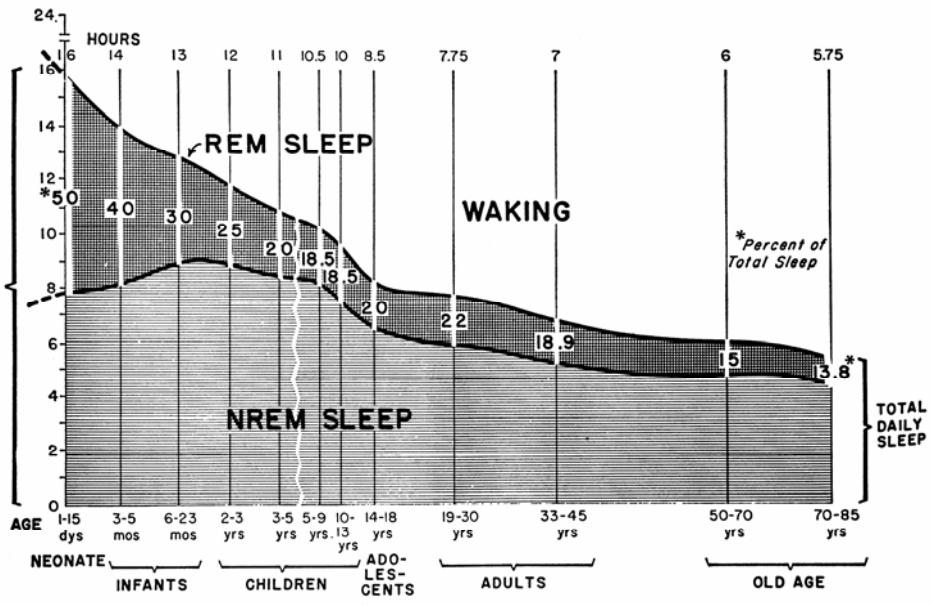

Figure 2. Distribution of REM/NREM sleep with increasing age (Roffwarg, 1966).

1.1.2. Anatomical and neurophysiological correlates of sleep

Sleep is an active neurobehavioral state that is maintained through a highly organized interaction of neurons and neural circuits in the central nervous system (CNS; Markov & Goldman, 2006). The neurologist Constantin von Economo (1931) was the first person who discovered the vital part played by the hypothalamus in sleep. Von Economo (1931) noted

that damage of the anterior part of the hypothalamus cause insomnia and lesions of the posterior part of the hypothalamus cause sleepiness. Studies by other researcher in the 1940s found that lesions in the basal brain also induce sleep suggesting that there is a wakefulness-promoting region located in the hindbrain. These early findings about the importance of the anterior and posterior hypothalamus as well as of the brainstem have turned out to be broadly valid (Foster & Kreitzman, 2005). Without going into details, the location of the brain nuclei and relevant neurotransmitters involved in sleep generation are shown in Figure 3.1. Figure 3.2 illustrates the major interactions of the brain structures involved in the generation of sleep and wake. The circadian modulation of sleep originates within the suprachiasmatic nuclei (SCN, see also section 1.2.1) and is likely to involve the rhythmic production of melatonin from the pineal gland. The ventrolateral preoptic nucleus (VLPO) is linked with the lateral hypothalamus (LH) and the various nuclei that constitute the ascending arousal system (LDT, PPT, LC, DR, TMN) and promotes sleep by releasing the inhibiting neurotransmitter GABA. The awake state is promoted by the release of orexin from the lateral hypothalamus (LH) and the activation of the ascending arousal system. The switch from NREM/REM sleep is achieved by the interaction of the LDT, PPT, BRF, LC and DR (Foster & Kreitzman, 2005). Understanding the interactions between brain structures is one of the biggest challenges in neuroscience, and is part of the bigger programme of determining how all of the brain's systems together create the collection of behavior that we call 'the self' (Foster & Kreitzman, 2005).

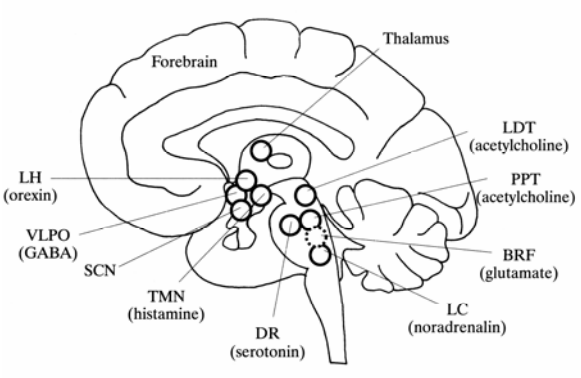

Figure 3.1. Location of the brain nuclei and relevant neurotransmitters involved in sleep generation (from Forster, 2005). BRF, brainstem reticular formation; DR, dorsal raphe nucleus; GABA, gamma-amino butyric acid; LC, locus coeruleus; LDT, laterodorsal tegmental nuclei; LH, lateral hypothalamus; PPT, pedunculopontine tegmental nuclei; TMN, tuberomammillary nucleus; VLPO, ventrolateral preoptic nucleus.

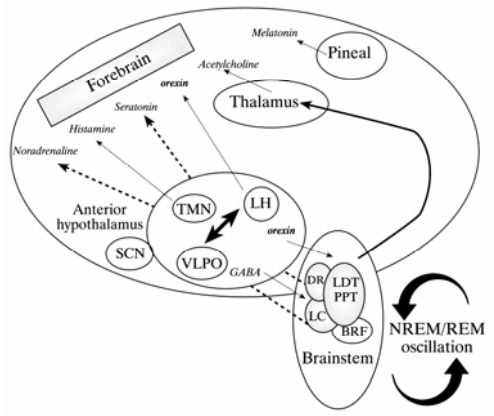

Figure 3.2. Illustration of the major interactions of the brain structures involved in the generation of sleep and wake (from Forster, 2005).

1.2. Sleep/wake regulation

1.2.1. 2-Process model of sleep/wake regulation

Beside the interactions of neurons and neuronal circuits in CNS, sleep is a regulated process. Current theoretical models of sleep regulation (Borbély, 1982; Daan et al., 1984) describe two intrinsic interacting processes that consolidate sleep and wakefulness: a circadian and a homeostatic process (Figure 4, first two lines). The latter accounts for an increase of sleep pressure as waking is extended and for a recovery process occurring during sleep regulating the duration and intensity of sleep. In contrast, the circadian process is a sleep-wake independent, clock-like process determining the timing of sleep and wake within the 24-hours period.

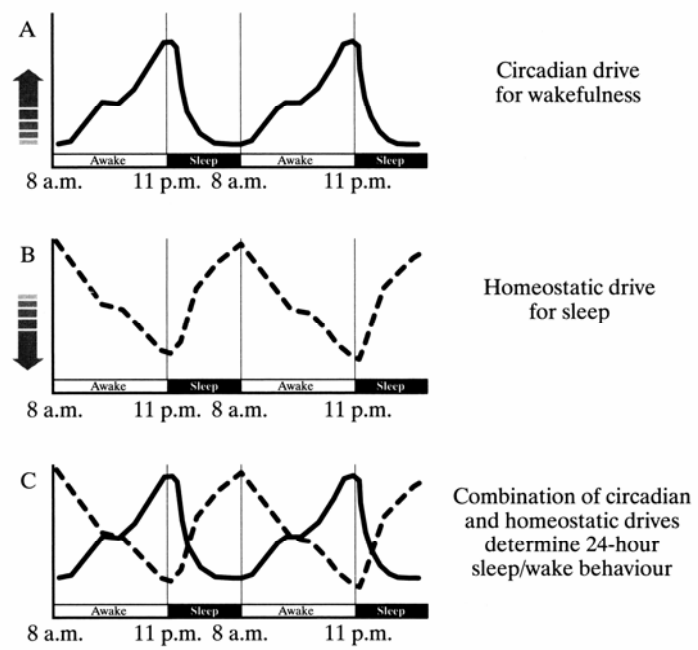

Figure 4. The 2 opponent-process model of sleep/wake regulation (from Forster, 2005).

The circadian process is mainly controlled by a "master" pacemaker located in the suprachiasmatic nucleus (SCN) of the hypothalamus. The SCN is composed of thousands of neurons that each possesses a circadian oscillator generating and sustaining endogenuous rhythmicity (Aschoff, 1976; Dijk & Czeisler, 1995; Van Gelder, 2004). In its simplest form, the molecular clock-work consists of autoregulatory transcriptional and translational feedback loops that have positive (e.g., CLOCK, BMAL1) and negative elements (e.g., *Period* genes) (Brown et al., 2008; Cuninkova & Brown, 2008; Shearman et al., 2000).

The free-running period of the biological clock has a period slightly shorter or longer than 24 hours and a phase relative to the time of day (Dunlap, 1996; Van Gelder, 2004). Thus,

the circadian clock generates not only a cycle to match the solar day; it must also maintain an appropriate phase relation to it (Wirz-Justice, 2007). This process of optimal synchronization with the environment is called entrainment and is mediated by periodic stimuli (also called "zeitgebers") acting on the clock. Because light, providing the photic signal for day and night, is the most stable time cue, the SCN is adjusted to time of day by the light input from the eyes via the optic nerve and the retinohypothalamic tract. There are two different modes of photoreception in the eyes. A visual photoreception which sends a highly mapped projection to the visual centre of the brain providing us with the image of the environment and a non-visual photoreception which carries the light information signal to SCN neurons (Foster & Soni, 1998). Beside central clock genes, circadian oscillation was also found in peripheral cells of the body (e.g., brain, heart, lung). The SCN pacemaker and the peripheral clocks have different qualities, forming a hierarchy within the circadian system (Roenneberg & Merrow, 2003). Current knowledge indicates that SCN clock entrains the phase of peripheral clocks through a redundant mix of direct hormonal and nervous signals, and indirect by environmental cues (e.g., feeding, body temperature; Cuninkova & Brown, 2008).

The phase of the entrained circadian clock depends on the endogenuous, free-running rhythm: the shorter the free-running period of the circadian clock, the earlier is its phase relative to the entraining day and sleep/activity is moved to an earlier phase (individual differences are also known as chronotypes, see also section 1.3.1.1; (Roenneberg et al., 2003). Furthermore, the phase of entrainment is also determined by characteristics as a) strength of the Zeitgeber, b) genetic differences in sensitivity of the receptor, c) genetic differences in efficiency of the input transduction cascade, d) variation of the period of the rhythm generator (SCN) created by the interaction of the negative and positive feedback driver of the clock mechanism, and e) genetic differences in output signal (Figure 5).

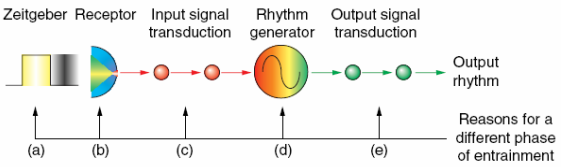

Figure 5. Reasons for different phases of entrainment (from Roenneberg et al., 2003).

The circadian system is often depicted as a pathway from the input that receives the zeitgeber signals to the output that controls the observable rhythms, with the mechanism that generates the circadian rhythmicity at its centre. Beside sleep-wake patterns and cognitive functions many aspects of physiology show a circadian regulation [e.g., cardiac function

(heartbeat and blood pressure), renal function, and most aspects of digestion (enzyme secretion)] and about 10% of genes have circadian patterns of expression (Brown et al., 2008).

While the circadian process has a distinct anatomical locus and can be assessed by different physiological measures (e.g., melatonin, body temperature), the homeostatic process is less well defined on a anatomical or molecular level. One marker for the sleep pressure intensity is sleep latency. Higher sleep pressure, as it is known from sleep deprivation studies (Carskadon & Dement, 1979; Drummond & Brown, 2001; Harrison et al., 200), induces a reduction of sleep latency. On a physiological level, the EEG slow wave activity (SWA) of non rapid eye movement (NREM) has been proposed as a measure for sleep homeostasis (Borbély, 1982). A recent hypothesis by Tononi and Cirelli (2006) suggest that SWA itselfs may be regulated by synaptic strength. According to the synaptic homeostasis hypothesis, plastic processes occurring during wakefulness result in a net increase in synaptic strength in many brain circuits, just reaching a maximum before going to sleep. Then, as soon as sleep ensues, total synaptic strength begins to decrease, and reaches a baseline level by the time sleep ends (Tononi & Cirelli, 2006).

Current models of sleep regulation include an integrative view in which the homeostatic and the circadian system operate as opponent processes (Edgar et al., 1993), which enable the consolidation of sleep and wakefulness (see Figure 4, last line). In other words, in the first few hours after awakening, sleep drive is very low. At this time, the circadian drive for wakefulness does not have to be very strong to keep us alert. As the day progresses, the result of the tension between the drives is a biphasic pattern of daytime alertness, with a “midday dip” occurring in the mid-afternoon. While many societies are used to allow a daytime nap or siesta, our western society forces us to get us through this down period (Broughton, 1998; Jenni & O'Connor, 2005). By late afternoon the circadian wakefulness is in full swing, keeping us going against the rising sleep drive. In the evening then, we are surprisingly alert, even more so than earlier in the day and despite having been awake longer. Thus, the increasing circadian drive during the waking period counteracts the growing homeostatic sleep pressure in order to maintain a balanced waking state (Borbély, 1982; Edgar et al., 1993). The adjustment of circadian and homeostatic process is essential for balanced daytime behavior as well as for restorative sleep; maladjustment or misalignment of these two processes may lead to sleep difficulties (e.g. difficulties falling asleep, sleeping through the night) as well as to imbalanced daytime behaviour (e.g., irritability, mood disorders; Jenni, 2009).

1.3. Sleep/wake regulation in childhood

The development of the sleep-wake system is one of the first markers of early biobehavioral organization and adaptation (Prechtl et al., 1973; Thoman, 1975b; Thoman, 1975a). While immediately after birth, wake and sleep episodes are randomly distributed across day and night, with increasing age the polyphasic sleep pattern shifts to a monophasic pattern (Figure 6). While the circadian process may already function in utero, several studies suggest that sleep homeostasic processes emerge in the second month of life when homeostatic sleep pressure increases during the course of the day (Jenni & Carskadon, 2004; Peirano et al., 2003; Salzarulo & Fagioli, 1992).

Homeostatic and circadian processes may not develop at the same rate. In the first 6 months, there is a risk for misalignment of the homeostatic and circadian process which may manifest in the high prevalence rate of sleep disturbances in these age range as well as in early childhood (Anders & Eiben, 1997; Jenni et al., 2005b; Mindell, 1993; Stores, 1996). A not yet opposed homeostatic sleep pressure by circadian processes in infants may result in hyperalertness, hyperarousal and excessive crying (Jenni & LeBourgeois, 2006).

Furthermore, a gradual reduction of sleep need by a significant increase in waking time leads to consolidated sleep. Sleep duration across childhood declines (Figure 7; children need more sleep than adolescents and adults) and the timing of sleep and wakefulness undergoes a gradual shift to later bedtimes and sleep onset times, beginning in middle childhood and accelerating into early to mid adolescence. This shift is often accompanied by irregularities in sleep-wake patterns, characterized by increasingly larger discrepancies between school and non-school bed and wake times as well as with increased weekend-oversleep. Until recently, the delay of the sleep phase was viewed to originate in changes in the psychosocial milieu (e.g., extracurricular activities, increase in night-time activities, etc.). Because different studies in numerous societies around the world and studies under strict control of psychosocial influences have consistently described changes of sleep-wake patterns, sleep researchers concluded that maturational changes in the biology of circadian and homeostatic processes drive the sleep phase delay (Carskadon & Acebo, 2002; Carskadon et al., 2004; Jenni et al., 2005b).

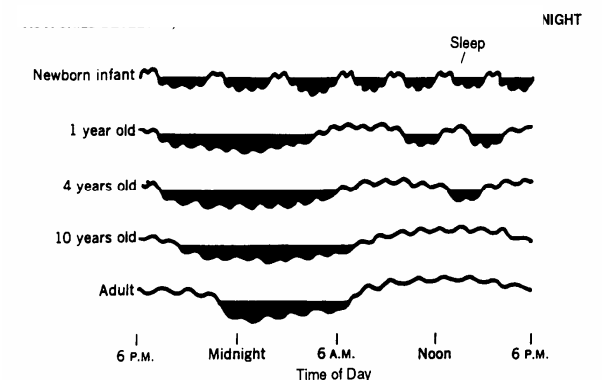

Figure 6. Polyphasic and monophasic sleep patterns. (from Borbély, 2004).

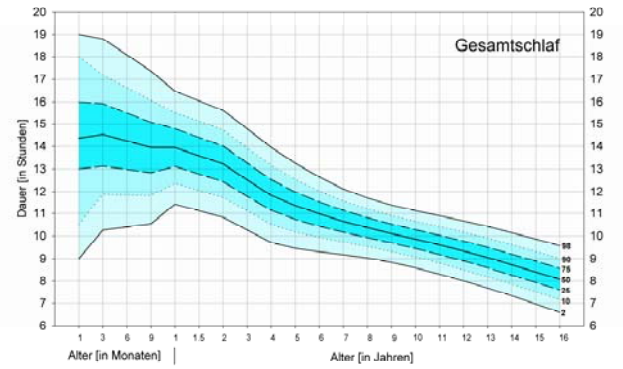

Figure 7. Sleep duration declines over age (from Iglowstein et al., 2003).

1.3.1. Evaluation of children's sleep-wake patterns

As mentioned above, the homeostatic process regulates the duration and intensity of sleep, while the circadian process determines the timing of sleep and wakefulness within the 24-hours period. The assessment of individuals' sleep duration and circadian sleep phase preference is of great clinical importance and gives an estimation of the two opponent processes of sleep/wake regulation. In contrast to children's sleep duration which can easily be assessed (direct or computed out of sleep onset and sleep end times), until now, little is known about assessing children's sleep phase preference by subjective reports.

1.3.1.1. Assessment of children's chronotypes

The term chronotype refers to individual's circadian sleep phase preference. Chronotype is an individual difference characteristic reflecting the time of day at which individuals are "at their best" (Guthrie, 1995; Kerkhof, 1985). While some people prefer to wake up early in the morning and are most alert in the first part of the day (e.g. larks or morning types), others' peak time of day is during the evening hours and prefer to go to bed late at night (e.g. owls or evening types; Cofer et al., 1999; Tankova et al., 1994). Studies in adults and adolescents show that morning-types (also called "larks") have an earlier sleep schedule (e. g., Carskadon et al., 1993; Horne & Östberg, 1976; Kerkhof & Lancel, 1991; Mecacci & Zani, 1983), an earlier circadian temperature phase (e.g., Bailey & Heitkemper, 2001; Duffy et al., 1999; Kerkhof, 1991; Kerkhof & Van Dongen, 1996; Mongrain et al., 2004), an earlier melatonin secretion pattern (Laberge et al., 2000), and report fewer difficulties with sleepiness and attention (Giannotti et al., 2002) than evening-types ("owls").

Thus, individual differences in chronotype are linked to sleep schedule variability, psychosocial functioning, and specific properties of the circadian clock.

Chronotype is also referred to as 'morningness/eveningness' (M/E) preference, which reflects an individual's standing on a continuum between two extremes (Natale & Cicogna, 2002) while approximately 80% of the population are neither extreme larks nor extreme owls but are somewhere between. Beside physiological measures (e.g., melatonin), chronotype is assessed through self-report questionnaires. In adults, Horne and Östberg's Morningness-Eveningness Questionnaire (MEQ; Horne & Östberg, 1976) estimates M/E preference by asking respondents about their preferred timing of sleep and daily activities. The MEQ has been validated across a variety of samples (e.g., Chelminski et al., 1997; Posey & Ford, 1981; Taillard et al., 2004), translated into several languages (e.g., Mecacci & Zani, 1983), and revised into other versions [e.g., Smith's Composite Scale of Morningness (CSM; Smith et al., 1989), Adan and Almirall's rMEQ (1991)]. To evaluate M/E preference in adolescents, Carskadon and colleagues (1993) modified adult measures of chronotype (Horne & Östberg, 1976; Smith et al., 1989) into an adolescent-friendly self-report of daily preference. In contrast to these multi-item measures, Roenneberg and colleagues (Roenneberg et al., 2003) developed the Munich ChronoType Questionnaire (MCTQ), which estimates individual's circadian preference by a single phase-reference point, the mid-sleep point on free days (MSF). The self-report MCTQ has been used in adults, adolescents, and children as young as 10 years of age (Roenneberg, Date accessed: 12.11.08). The MCTQ's validity in adults and adolescents is evidenced by strong concordance with MEQ scores (MSF: r=-.73; Zavada et al., 2005) and with CSM scores (MSF: r=-.62; Randler, 2008). Reliability and validity data for MSF in children, however, have not been reported. Furthermore, a parent-reported version for assessment of chronotype in prepubertal children is not currently available.

The assessment of individual chronotype is important not only for the diagnosis and treatment of circadian sleep disorders (Baehr et al., 2000) and for predicting the ability to adapt to specific work schedules (Costa et al., 1989; Costa et al., 2006; Pisarski et al., 2006), but also for improving individual's daytime performance by matching sleep schedules to circadian biology (Silva, 2008). In particular, extreme evening types are at higher risk than morning types of not obtaining sufficient sleep and performing poorly due to discordance between their individual circadian rhythm and social demands [e.g., work and school schedules (Takeuchi et al., 2001; Wittman et al., 2006)]. Evidence is also accumulating that subjects have more difficulties in maintaining sleep when sleep is scheduled at adverse circadian phases (Silva, 2008).

1.3.2. Different assessment approaches for children's sleep wake-patterns

Sleep is studied in the laboratory by monitoring the pattern of an individual's electrophysiological activity by electroencephalogram (EEG). As many sleep disorders in children are not related to abnormal sleep structure and, at least in adults insomnia patients, there is a sleep state misperception (Feige et al., 2008; Riemann et al., 2009), tracking the microstructure of sleep in the laboratory for one or two nights is not the appropriate method for the identification and management of sleep problems (Monk et al., 1994).

A frequent approach to assess the child's sleep-wake patterns is simply to ask the parents as part of the interview. Additional data may be collected either by standardized questionnaires or sleep diaries which visualize sleep patterns over time. Other methods include actigraphy providing a reliable and objective estimation of sleep times and interruptions over multiple days (Sadeh, 1994; Sadeh et al., 1991).

Wrist acticraphy has emerged as the most popular alternative to PSG (Paquet et al., 2007) due to its low invasiveness and cost and the ease of monitoring sleep-wake patterns in ecological environments. An actigraph is a small, wrist-worn device that contains an accelerometer to monitor the number of wrist movements per epoch (e.g., 30 or 60 seconds). Scoring algorithms are used to identify sleep and wake states from activity counts and to determine sleep/wake parameters. For clinical and research purposes, several types of devices are used (e.g., Actillume, Actiwatch, Motionlogger, Gaehwiler, etc.) and each of these devices records activity in different ways and also has unique algorithms for estimating sleep/wake parameters from activity counts, so that the raw activity counts and sleep/wake parameters may or may not be comparable (Paquet et al., 2007). The ability of actigaphy to discriminate between sleep and wake as defined by PSG criteria has been evaluated by a number of studies. In an extensive literature review of the role of actigraphy in sleep research, (Ancoli-Israel et al., 2003) reported that actigraphy and PSG show overall minute-by-minute concordances of 91-93% in adult populations. In a more recent review, Acebo et al. (2006) reported high epoch-by-epoch agreement rates (>85%) between actigraphy and PSG in healthy subjects of different age groups. Despite these high agreement rates, the major concern of actigraphy is that actigraphy estimates occasionally report false negatives (actigraphy scores wake when the subject is sleeping) and false positives (actigraphy scores sleep when the subject is awake). Furthermore, there is a large inter-individual variability in movement intensity during sleep episodes for which theoretically should be accounted for (Paquet et al., 2007).

Overall, the most commonly employed methods in basic and clinical sleep research and clinical paediatric sleep medicine are different in terms of duration, effort, cost and source of information. Interview procedures, questionnaires and diaries are based on parental reports (subjective information), whereas actigraphy or PSG records objective measures of the child's sleep-wake patterns derived from movements, respectively electrophysiological activity. The source of information (subjective versus objective) in the evaluation of sleep-wake patterns has been a topic in several studies with different populations (adults versus children, normal versus clinical samples) and different devices (Acebo, 2005; Kushida, 2001; Lockley, 1999; Sadeh, 1996; Tikotzky, 2001). It has been repeatedly demonstrated that subjective compared to objective reports are limited by the restricted and biased knowledge that parents have about children's sleep (Sadeh, 1996). However, parental reports remain a time- and cost-effective way of collecting data in the research and clinical setting. Furthermore, as polysomnographic research on insomnia patients in adults revealed that there is a remarkably discrepancy between the subjective experience of insomnia and polysomnographically estimated measures of sleep (sleep state misperception), subjective reports contain useful information about individual's or parents' perception and cognition for children's sleep-wake patterns (Feige et al., 2008; Paquet et al., 2007; Riemann et al., 2009).

1.4. Sleep disturbances

There is a large variety of sleep disorders as for example insomnia, sleep apnea syndrome, or restless legs syndrome. The most prevalent of all these is insomnia, which refers to the complaint of insufficient quantity and quality of sleep despite adequate sleep opportunity (Revel et al., 2009). In children, insomnia manifests most commonly as bedtime resistance, sleep onset difficulties and/or frequent night wakings.

1.4.1. Diagnosis and phenomenology in general

The available clinical classification systems, the DSM-IV [Diagnostic and Statistical Manual of the American Psychiatric Association (1994)], the ICD-10 [International Classification of Diseases (2007)], and the ICSD-R [International Classification of Sleep Disorders, American Academy of Sleep Medicine (2005)] distinguish primary sleep disorders such as dyssomnias and parasomnias from sleep disorders associated with a large number of mental, neurologic or medical disorders (secondary sleep disorders).

Dyssomnias include a heterogeneous group of disturbances that originate in different body systems and that produce either difficulties in initiating or maintaining sleep which have to be coupled with the experience of nonrestorative sleep and impairments in daytime functioning (e.g., lack of concentration or alertness). On the other hand, parasomnias are sleep disorders that usually do not cause a complaint of either insomnia or excessive daytime sleepiness, but are undesirable phenomena occuring during sleep (e.g., sleep walking). The ICSD-R subdivides dysomnias along pathophysiologic lines, into intrinsic, extrinsic, and circadian-rhythm disorders. The distinction between intrinsic and extrinsic sleep disorders divides the major causes of insomnia into those that are induced primarily by factors within the body (e.g. narcolepsy) and those produced by factors outside the body (e.g., inadequate sleep hygiene). For the diagnosis of a sleep disorder, the complaint has to be present for more than of the half of the days and endure for at least 4 weeks (ICSD-R). The disorder may be classified by severity (mild, moderate, severe) and duration (acute, sub-acute, chronic).

1.4.2. Diagnosis and phenomenology in children

For children, the classification of sleep disorders is not straightforward. Some authors have noted that there is a lack of common nosology for sleep disorders in children (Owens, 2007). There are several difficulties in reliably diagnosing sleep disorders in children. First, sleep disorders should be inappropriate for the actual developmental stage of the child and understood in the context of normal physical and cognitive-emotional phenomena that are

occurring at different developmental stages (Owens, 2007). For example, an increase in night-time fears and night waking in toddlers may be a temporary manifestation of developmentally normal separation anxiety or as children develop language skills, cognitive reasoning and imagination; they may develop difficulties with initiating sleep (fears of dark and monsters). While some colleagues rely for the definition of abnormal sleep on comparison with normative populations, others use a priori definitions, which are tailored for age and developmental level and others also account for cultural, racial-ethnic, environmental, and social influences. Second, significant impairments in daytime functioning are mostly reported by the parents (not by the child itself). Because childhood sleep disturbances may affect the whole family, many researchers and clinicians found that the definition of sleep disturbances must acknowledge the validity of parental concerns and opinions regarding their child's sleep patterns including the resulting stress on the family. This approach may not adequately account for developmental considerations and may be determined by the amount of disruption caused to parents' sleep. Parental recognition and reporting of sleep problems in children varies across childhood with parents of infants and younger children more likely to be aware of sleep concerns than those of older children and adolescents.

1.4.3. Prevalence of childhood insomnia

In adults and children, insomnia is a common health complaint affecting between 5% to 30% of the population depending on the criteria applied (Ohayon, 2002). Sleep problems such as bedtime struggles and night waking are some of the most common behaviour problems encountered for younger children. Of 1 to 2 year old children, 13-20% regularly wake and 6-10% have a severe problem (N. Richman, 1981). At 3 years of age the frequency has been quoted as being as high as 29% (Zuckerman et al., 1987). And a recent study of over 14'000 school-aged children (Pagel et al., 2007) found sleep problems in 20% of 5 year olds and 6% of 11 year olds indicating that the prevalence of childhood sleep problems tend to decrease with age (see Figure 8).

Overall, Owens et al. (2007) indicate that approximately 25% - 30% of all children experience some type of sleep problem at some point during childhood, ranging from short-term difficulties in falling asleep and night wakings, to more serious primary disorders, such as obstructive sleep apnea. Moreover, sleep problems in children and adolescents with chronic medical, neurodevelopmental, or psychiatric disorders are more prevalent and are the most common cause of chronic insomnia (Owens, 2007).

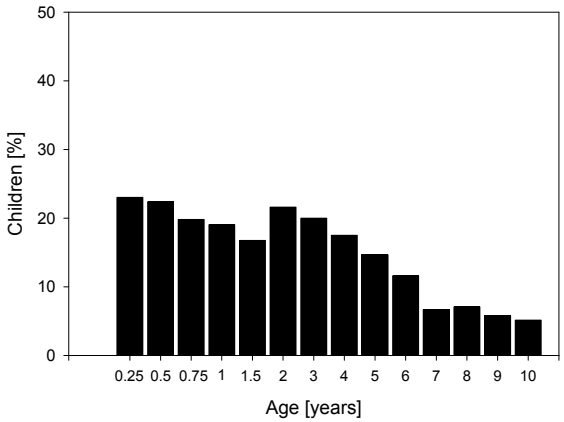

Figure 8. Frequency of night waking in the first 10 years of life (adapted from Jenni et al., 2005b).

1.4.4. Course and outcome of childhood insomnia

Although many sleep problems in infants and children are transient and self-limited in nature, a number of studies have documented both the persistence and recurrence of infant sleep problems into later childhood (e.g., Jenkins et al., 1984; Jenni et al., 2005b; Kataria et al., 1987; Lam et al., 2003; Wolke et al., 1994). The majority of paediatric sleep disturbances, if left untreated, do likely persist for years or decades or may also gradually worsen over time (Meltzer & Mindell, 2006). Sleep disorders may have a negative impact on individual's development, including learning, growth, and emotion regulation (Fallone et al., 2002; Mindell & Owens, 2003). Furthermore, patients suffering from primary sleep disorders are at risk for later developing psychiatric conditions (Morrison et al., 1992; Pollock, 1994; Zuckerman et al., 1987) as well as for substance abuse disorders (Giannotti et al., 2002; Lavigne et al., 1999).

1.5. Theoretical models for the development of childhood insomnia

Because sleep is sensitive to endogenous and environmental factors, the source of sleep disturbances is broad. Thus, there are many theoretical models for the development of sleep disorders in adults. Stress-related models, for example, indicate that stress as a state of physiological activation and arousal is inhibitory to sleep (Revel et al., 2009) and that upon cessation of the stressful situation (e.g. noise), the inhibitory effect on sleep disappears so that sleep quantity and quality increases subsequently (Revel et al., 2009). In contrast, theoretical models for sleep disorders in children are rare.

1.5.1. A transactional model for children's sleep-wake patterns

Sadeh and Anders (1993) conceptualized a transactional process model of sleep-wake regulation assuming that children's behaviour and symptoms (e.g., sleep disorders) are dynamic and involve participants and context bidirectional (e.g., parental behaviour). Figure 9 illustrates a transactional model and gives an overview of involved components for children's sleep-wake patterns as well as of the ongoing dynamic interactions and bidirectional influences between the child and his or her social environment (Sadeh & Anders, 1993). The different components can be seen as part of the relationship context, either distal and proximal, or extrinsic and intrinsic.

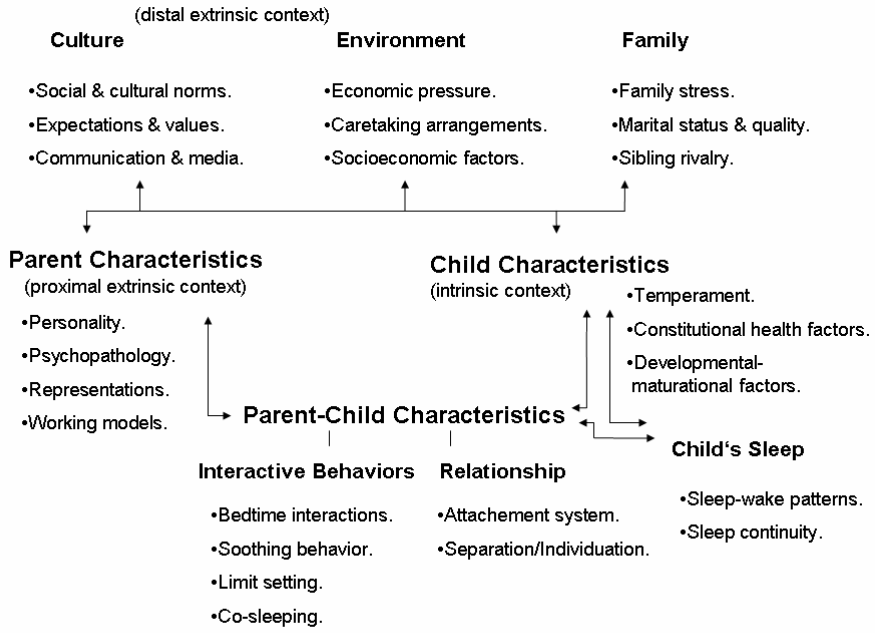

Figure 9. Transactional model of involved components for children's sleep-wake patterns (from Sadeh & Anders, 1993).

Child characteristics for example include behavioural style (e.g., temperament; (Atkinson et al., 1995; Scher et al., 1992) and biological variables [genetic factors (e.g., Shaw & Franken, 2003), chronotype (e.g., Werner et al., 2009), maturational processes (e.g., Carskadon et al., 2004), illness (e.g., Opp et al., 1995; Opp & Toth, 2003)]. Parent characteristics such as parenting or discipline styles, mental health status (e.g., Bayer et al., 2007), education level or knowledge of child development as well as family stress (e.g., Pawlik et al., 2008), sleep environment and lifestyle issues have been suggested as contributing factors to children's sleep-wake patterns. Finally, interactive factors such as specific bedtime parental behaviours (e.g., co-sleeping; Lozoff et al., 1996; Morrell, 1999) and the attachment relationship (Anders, 1994; Benoit et al., 1992; Scher, 2001) have also been found to be influential. Thus, it may be speculated that children's sleep-wake regulation is mediated by parent-child relationships and interactions but influenced mostly by the child intrinsic context in interaction with the proximal extrinsic parental context which on the other hand are influenced by more distal components (culture, environment, family).

1.5.2. Children's sleep disorders in the context of 'goodness of fit'

Transactional developmental models in general (dynamic interactional theories) assume that children may act to produce their own development and may promote differential reactions in their caregivers (Lazarus & Launier, 1978; Sameroff, 1983). These reactions constitute feedback to the child. A feedback that provides experiences influencing the course of the child's further development. The specific nature of the feedback children receive (positive or negative) can be understood by referencing to the concept of 'goodness of fit', a notion first used by Thomas & Chess (1977, 1984).

In line with other researchers (Darwin, 1872; Erikson, 1971; Freud, 1948) Thomas & Chess (1977, 1984) suggested that in order for healthy development individuals must coordinate or match its characteristics and functional capabilities with the demands of its context. Thomas & Chess (1977, p. 11-12) indicated that "goodness of fit results when the properties of the environment and its expectations and demands are in accord with the organism's own capacities, characteristics, and style of behaving. When consonance between individual and environment is present, optimal development in a progressive direction is possible. Conversely, poorness of fit involves discrepancies and dissonances between environment and opportunities, demands and the capacities of the organism, so that distorted development and maladaptative functioning occur. Goodness of fit is never an abstraction, but is always only in terms of the values and demands of a given culture or socioeconomic group". Therefore, positive exchanges and feedbacks as well as healthy development occur,

when the child's characteristics are in accordance with the majority environmental expectations and demands. Or in other words: A misfit between parental expectations and demands and individual characteristics (e.g., development) may lead to behavioural and developmental disturbances (Largo & Jenni, 2005; see Figure 10).

In this context, sleep difficulties may not only be associated with a misalignment between homeostatic and circadian process as mentioned above, but although with a misalignment between endogenous (e.g., sleep need, chronotype) and environmental components (e.g., parental expectations for children's sleep-wake patterns; Jenni & O'Connor, 2005). However, once present, the effects of a sleep problem are circular, affecting the relationship-interaction context, parental well-being, the harmony of the family and even child's biological variables (Sadeh & Anders, 1993).

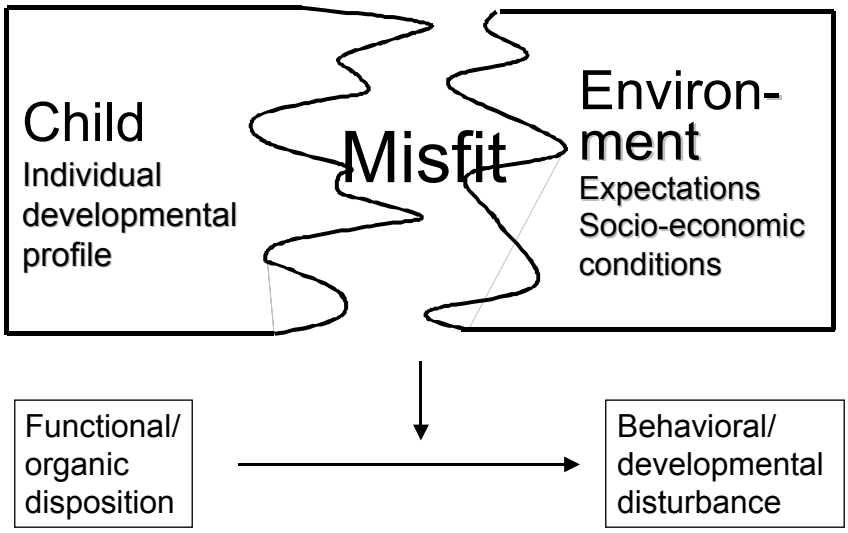

Figure 10. Illustration of Misfit between parental expectations/demands and individual characteristics (e.g., development; adapted from Largo, 2008).

1.5.3. Children's sleep disturbances in the context of the family

Children's sleep problems are stressful and disruptive to family life (N. Richman, 1985) and have an impact on parental sleep and marital relationships (Meijer & van den Witenboer, 2007; Meltzer & Mindell, 2007). Although these studies indicate significant correlations, they may not point to causality. It could be that having a child who sleeps poorly (i.e., frequently waking up during the night) may have strong effects on parental stress levels via chronic sleep interruptions, but it may also be that stressed parents' inadvertently contribute to or reinforce the sleep problems, perhaps by changes in the quality of their care and by indulging their children (Boergers et al., 2007; Doo & Wing, 2006). Nevertheless,

(Doo & Wing, 2006) demonstrated that parents of sleep disturbed children are likely to experience significantly higher levels of parenting stress than parents of non sleep disturbed children.

Originally, Cannon (1914) developed the concept of stress as a term for the physiological reaction due to a stressor (e.g., a threatening situation). In contrast to the biological stress concept which focuses on a person's reaction to a stress-provoking stimulus (Selye & Fortier, 1949; Seyle, 1985), later developed psychological concepts focus on the subjective experience between the pressure to reaction and the options for adaptive reactions (Folkman, 1997; Lazarus, 1984; Mason, 1975). Therefore, a stress-provoking situation (e.g., children's sleep disturbances) might be stressful for some parents, while the same situation can be experienced as controllable by others.

1.5.4. Parental distress

Parenting is a highly complex task that often must be performed within demanding situations, with limited personal and physical resources, and in relation to a child who by virtue of some mental or physical attribute may be exceedingly difficult to the parent (Abidin, 1995). According to Lazarus' transaction theory of stress (Lazarus, 1993), individual differences in stress response to the same stressor are caused by variations in the way individuals appraise stress. In his model, Lazarus and Folkeman (1984) define stress as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being". Thus, parent-child interactions and resulting interactive stress must be seen as a function of the complex interplay among parent, child and environmental characteristics (Mash & Johnston, 1990).

Several researchers have conceptualized theoretical models about how these factors affect parenting attitudes or parental distress (Abidin, 1995; Belsky, 1984; Mash & Johnston, 1990; Webster-Stratton, 1990). The model of Abidin (1995) includes some variables that appear among those of importance in understanding parental stress, although the model did not adequately recognize parental cognitions and perceptions that are involved in the experience of parenting stress as well as the interactive effects of the variables (see Figure 11 and 12).

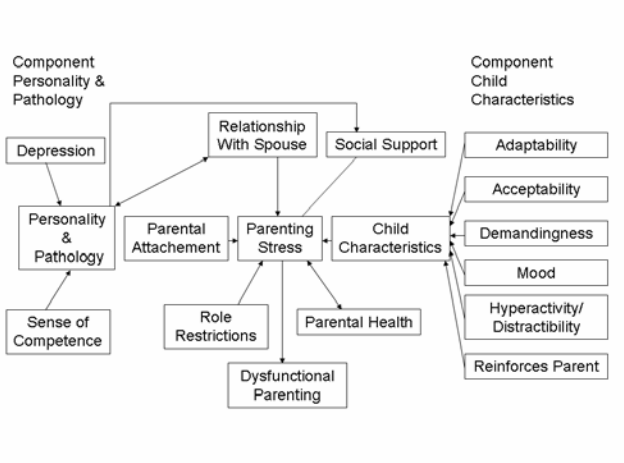

Figure 11. Parenting stress model of Abidin (1995).

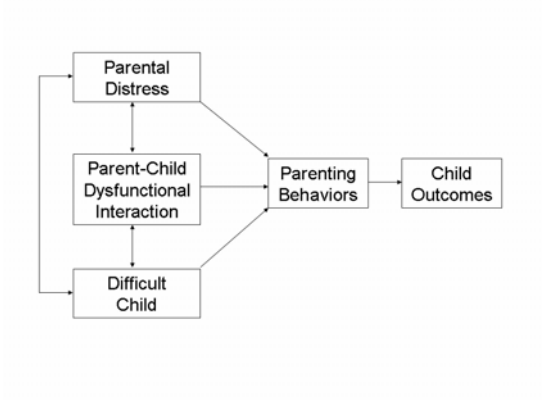

Figure 12. Parenting stress model of Abidin (1995; short form).

However, psychological distress arising from parenting demands contributes to the development of dysfunctional parent-child relationships and further stress and constitutes a risk factor for child's adjustment, development and psychopathology (Abidin, 1995; Deater-Deckard et al., 1998; LeVine, 1974).

1.5.4.1. Parental distress and parental expectations

Clinical and research evidence in adults suggest that sleep related cognitions such as false beliefs, worry, and attention bias (e.g., unrealistic expectations about sleep requirement) play an important mediating role in perpetuating or even exacerbating insomnia (Perlis et al., 1997). In children, parental expectations for children's sleep-wake patterns are of great importance. Richman et al. (1988) for example indicated that parents consider much attention to their child getting enough sleep (14 hours a day was seen as adequate), even when the child shows great resistance to nap or sleep.

LeVine (1974) was one of the first who examined the influence of cultural values as well as past and present environmental pressures on parental goals, beliefs and strategies for child care. Thus, his parental goal theory (1974) provided an explanation for the apparent inconsistencies found between parental explanations and actual observations of parenting behaviour (care strategies respond not only to the child's biology based characteristics and behaviours); parents can not always articulate why they do what they do because they are guided by cultural imperatives whose function lies beyond their awareness.

However, while there has been an increasing attention to the link between children's sleep and parental cognitions in the last 10 years (Morrell & Steele, 2003; Sadeh et al., 2007),

interactions between children and their parents in terms of expectancy effects are still largely neglected. The major component of research on interpersonal expectancy effects addresses the behavioural processes underlying self-filling prophecies (Rosenthal, 1989) proposed the following sequence of steps: 1) the perceiver forms the target in accordance with the expectancies; 2) the perceiver behaves toward the target in accordance with the expectancies; and 3) the target responds to the perceiver's behaviour. Because particular young children mostly do not behave towards expectations, there may be a high risk for 'poorness of fit'. Thomas & Chess (1984) indicated that it is excessive stress resulting from a poor fit between environmental expectations and demands and the capacities of the child at a particular level of development that leads to disturbed behavioural functioning (sleep disturbances).

1.6. Summary

Theoretical models for sleep disorders in children are rare. Because sleep is sensitive to endogenous and environmental factors, the source for sleep disturbances is broad. We know that children's sleep-wake regulation is strongly embedded in the family context and social practices (Owens, 2007). Thus, the alignment or misalignment between endogenous (e.g., sleep duration, chronotype) and exogenous components (e.g., parental expectations) may be considered as an important issue for understanding children's sleep disorders.

For diagnosing and evaluating children's sleep disorders, it is essential to have reliable and valid instruments. While sleep duration can be determined relatively easy, the assessment of the construct chronotype has been hindered by lack of appropriate measures. Based upon previous work of Roenneberg and colleagues (2004, 2003; Zavada et al., 2005) and Carskadon and others (1993), the present thesis aimed to develop a parent-report questionnaire for assessing children's chronotypes.

Children's sleep-wake patterns may be assessed by different methodological techniques and none of the previous reports provide the clinician or sleep researcher with information about the interchangeable use of different methods (Sheldon, 2007). Do parents accurately report on their child's sleep? Can methods be interchangeably used? Authors most often reported reliability estimates, comparisons of mean values and correlations between methods which do not provide appropriate information about agreement or disagreement between methods. Bland and Altman proposed limits of agreement for the interchangeable use of methods (with a 5% probability of error). Whether these limits are acceptable for the interchangeable use of compared methods needs to be answered from a clinical point of view (Bland & Altman, 1999).

Children's sleep disorders as well as sleep-wake regulation (and development in general) have to be studied in relation to characteristics of their primary caregivers (e.g., sleep-wake patterns, expectations, beliefs etc.). It seems obvious, for instance, that parents who consistently have troubles getting started in the morning interact and respond differently to morning-type children than to evening-type children. Discrepancies between children's and parents' sleep-wake patterns may modulate children's sleep quality or moreover may lead to dysfunctional interactions and thus to higher parental distress (Thomas & Chess, 1977, 1984). In addition, parental expectations for children's sleep-wake patterns may also play an important role in this context. The study of sleep-wake patterns of normal healthy children and their parents may provide insights into transactional processes that can eventually improve the clinical care for sleep problems in children. For understanding disorders, it is a prerequisite to have sufficient knowledge of the norm.

2. The Zurich Children's Sleep Study (the ZCSS)

The present Ph.D.-project is based on a study on sleep-wake patterns of healthy kindergarten children and their mothers which was conducted at the Child Development Center at the University of Children's Hospital Zurich between 2006 and 2008 (the ZCSS). The study was initiated due to current lack of empirical validation of a chronotype questionnaire for prepubertal children, the non-availability of empirical knowledge about agreement or disagreement between the most commonly used methods in basic sleep research and clinical paediatric sleep medicine and finally because of the scarcity of information concerning the association between children's and parents' sleep-wake patterns and its relation to parental distress. While much is known about sleep during infancy, the preschool years and adolescence, few literature can be found in the kindergarten and early school years.

As approximately 25-30% of the children experience some type of sleep problem during childhood (Owens, 2007), it is of great importance to have a valid and reliable questionnaire available assessing children's sleep patterns and phase preference, to have appropriate information about the interchangeably use of the most common used methods as well as to have normative information about the association of sleep-wake patterns within family members and its relation to parental distress.

The author of this doctoral thesis was employed as a research fellow to conduct the study under supervision of Dr. Jenni (Director of the Department of Child Development Center). She made crucial contributions to the study and was responsible for the development of the children's chronotype questionnaire (CCTQ), for the recruitment of participants (except for the school children), for the face-to-face interview conducted with the participants, for the data acquisition and for the statistical analyses. Up to now, the thesis author has published two scientific papers in peer-reviewed journals:

- Werner, H., Molinari, L., Guyer, C., Jenni, O.G. (2008). Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns. *Arch Pediatr Adolesc Med*, 162 (4), 350-358.
- Werner, H., LeBourgeois, M., Geiger, A., Jenni, O.G. (2009). Assessment of chronotype in 4-to11 year old children: Reliability and Validity of the children's chronotype questionnaire (CCTQ). *Chronobiology International*, 26 (5), 992-1014.

These two papers are reproduced in the present doctoral thesis (part 1 and part 2); the analyses of part 3 and part 4 are in preparation of publication. The study was supported by the Claus Cramer Foundation and the Theodor Herzog Egli Foundation.

2.1. Aims, research questions and hypotheses of the ZCSS

The aims of this study were to construct and validate a questionnaire to assess sleep phase preference (chronotype) for prepubertal children, to report agreement rates according to Bland and Altman (Bland & Altman, 1986, 1999) between the most commonly used methods in basic and clinical sleep (actigraphy, diary, questionnaire), to assess differences and associations between children's and mothers' sleep-wake patterns, and to explore whether these differences are related to parental distress. The following aims were pursuit in detail:

Part 1: Validity and Reliability of the Children's Chronotype Questionniare (CCTQ).

Based upon the previous work of Roenneberg and colleagues (Roenneberg et al., 2003); (Zavada et al., 2005); (Roenneberg et al., 2004) and Carskadon and others (Carskadon et al., 1993), we developed the Children's Chronotype Questionnaire (CCTQ) - a 27-item mixed-format parent-report scale for 4- to 11- year-old children, providing 3 individual measures of chronotype [mid sleep point on free days (MSF), a multi-item morningness/eveningness scale (M/E), and a 5-point chronotype item (CT)]. The purpose of part 1 were [1] to describe prepubertal children's chronotypes as assessed by the three individual measures; [2] to examine the concordance (validity) between children's chronotype measures and sleep/wake parameters (parental reports and actigraphic estimates); [3] to assess associations between the three children's chronotype measures; and [4] to examine test-retest reliability of chronotype measures and sleep/wake parameters.

Part 2: Limits of Agreement.

The aims of part 2 were [1] to describe sleep-wake patterns by measures derived from questionnaire, diary, and actigraphy and [2] to report rates of agreement between methods according to Bland and Altman (Bland & Altman, 1986, 1999).

Part 3: Children's and mothers' sleep-wake patterns assessed by actigraphy.

The aims of part 3 were [1] to describe children's and their mothers' sleep-wake patterns and the intra-individual variability of sleep-wake patterns by measures derived from actigraphy; [2] to assess differences and associations between children's and mothers' sleep-wake patterns; and [3] to explore common wake phases during the sleep period between mothers and children.

Part 4: Are children's and mothers' sleep-wake patterns related to parental distress?

The aims of part 4 were [1] to assess parental distress of mothers' of healthy kindergarten children; [2] to explore whether mothers' parental distress is related to children's and/or mothers' sleep-wake patterns, [3] to examine parental expectations for children's sleep-wake patterns, and [4] to study associations between parental expectations for children's sleep-wake patterns and parental distress.

The following research questions and hypotheses were addressed:

Part 1: Validity and Reliability of the Children's Chronotype Questionniare (CCTQ).

- Can children's sleep phase preference (chronotype) already be assessed by parent-report in prepubertal children? Is the CCTQ a valid and reliable instrument?
- Is there a concordance of children's chronotype measures compared to sleep/wake parameters?
- Are there associations between the three chronotype measures provided by the CCTQ?
- How are chronotypes of prepubertal children distributed in a community sample of healthy children?

We hypothesized that chronotypes as measured by MSF, M/E and CT can be reliably assessed in prepubertal children. We expected high associations between the three chronotype measures, while CT scores and M/E scores may be more strongly related than MSF and CT scores, respectively M/E scores. Furthermore, we expected that prepubertal children have earlier chronotpyes compared to adolescents and adults.

Part 2: Limits of Agreement.

- Do parents accurately report on their child's sleep patterns?
- How well do actigraphy, diary, and questionnaire data agree?
- Can these methods be interchangeably used? Is the diary as an important tool for the health care professional when evaluating children with behavioral sleep problems a reliable instrument?
- What are the agreement rates according to Bland and Altman (1986, 1999)?

We hypothesized according to the previous literature (Sadeh, 1996; Tikotzky & Sadeh, 2001) that for sleep start, sleep end, sleep duration, and mid sleep point actigraphy and diary data would well agree, while questionnaire data may differ substantially when compared to

actigraphy, but less so to diary data; we expected a lower agreement between methods in respect to nocturnal wakings.

Part 3: Children's and mothers' sleep-wake patterns assessed by actigraphy.

- Do children's and mothers' sleep-wake patterns as well as children's and mothers' the intra-individual variability of sleep-wake patterns differ?
- Are there associations between children's and mothers' sleep-wake patterns (e.g., sleep duration, chronotype)?
- Are there any common wake phases between mothers and children?

We hypothesized according to developmental changes in sleep regulatory processes (Carskadon, 1993; Jenni and Carskadon, 2009) that mean differences between children's and mothers' sleep scheduled variables differ significantly, while mean differences for sleep quality variables do not. Furthermore, we expected that night-to-night variability of sleep scheduled and quality variables significantly differ between children and mothers. We also hypothesized that children's and mothers' sleep duration and chronotype is significantly related to each other. Because the study included healthy kindergarten children (age 4-7 years), we expected no common wake phases (which is in contrast to younger children and infancy).

Part 4: Are children's and mothers' sleep-wake patterns related to parental distress?

- Are children's and/or mothers' sleep-wake patterns related to parental distress?
- Are differences between children and mothers for sleep-wake patterns related to parental distress?
- What are parental expectations for children's sleep-wake patterns of healthy kindergarten children? Are there any associations between parental expectations for children's sleep-wake patterns and parental distress?
- Does a 'misfit' between *ist* and *soll* sleep-wake patterns account for parental distress?

We hypothesized that distress of the mothers is significantly related to their sleep quality as well as to differences between mothers' and children's sleep duration and chronotype. Furthermore, we expected that inappropriate parental expectations for children's sleep-wake patterns may account for parental distress.

3. Methods

3.1. Study design

A cross-sectional field investigation of sleep-wake patterns in healthy kindergarten children and their mothers was conducted.

3.2. Subjects

Kindergarten children and their mothers (children in Switzerland attend kindergarten for 2 years between 4 and 7 years of age for about 4 hours per day with school start times between 8:15 and 8:30 a.m.) were recruited from 34 (13%) of 270 kindergarten schools in greater Zurich area. Overall, 660 families were addressed to participate in the study 1. 68 families (10%) finally agreed to participate. Inclusion criteria for participation in study 1 were (1) age between 4 and 7 years, (2) visiting a regular kindergarten class (2) no severe sleep problems in the prior 4 weeks of the study, (3) at least one parent is speaking the German language, (4) residence in greater Zurich area. All children of study 1 were recruited sequentially from May 2006 until July 2007.

For the evaluation of the Children's Chronotpye Questionnaires (CCTQ), additional kindergarten (n=67) and primary school children (n=46; children attend primary school in Switzerland about 6 hours per day on 5 days per week, starting between 7:45 and 8:15 a.m.) were recruited in 2007 and 2008 . The additional kindergarten children were recruited from 5 kindergarten schools in the greater Zurich area (from schools which have been already earlier addressed for study 1) and from friend-to-friend invitation. The 46 school children were recruited from primary schools and from school programs for gifted children. The 46 school children took part in a study about sleep and cognitive performance which was conducted at our center by the Ph.D. student Anja Geiger, supervised by Dr. Jenni and funded by the Center for Integrative Human Physiology (ZIHP) of the University of Zurich. The inclusion criteria for participation in these two studies were the same as mentioned above (except for the older age range for the school children).

The recruitment procedure of the studies is described in the flowchart of Figure 13. The research questions of the doctoral thesis are addressed by different sample sizes. Therefore, the reader is referred to the result sections of individual parts of this thesis for exclusion criteria and demographic characteristics (e.g., age, SES) of the specific sample. Different aspects of sleep disorders have been assessed (section Method section) and no participant met the criteria for a sleep disorder.

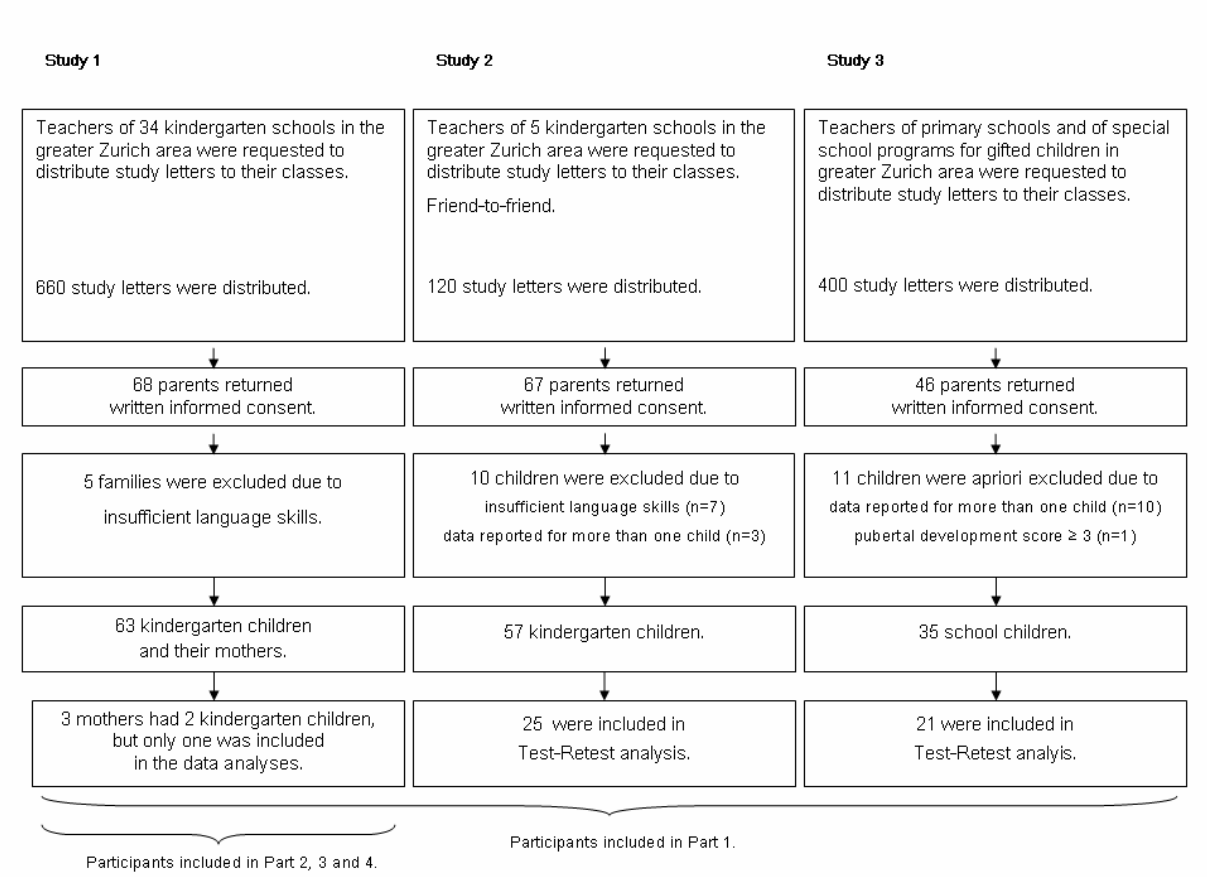

Figure 2. Flowchart of recruitment for the ZCSS.

3.3. Procedure

All studies were approved by the ethics committees of the University Children's Hospital and the Canton Zurich and were performed according to the Declaration of Helsinki. All families were informed about the study by letter and were requested to return written informed consent.

In case of participation for study 1 (see above), they were called to have a study appointment arranged for further explanation of the study procedures. The participants (children and mothers) were assessed by questionnaires, actigraphy and standardized face-to-face interview. Except in one case, mothers served as informants, most interviews were conducted in the family's home, and lasted between 60 and 90 minutes. The informants were asked to answer 2 questionnaires (CCTQ, MCTQ) prior to the interview and 4 during the interview (PSI-SF, EAS, SES, LEL). Actigraphy and diary data were collected following the interview. Diaries and devices were sent back by surface mail. Furthermore, during the face-to-face interview, actigraphy was explained and information about how to wear the actigraph as well as how to fill out the diary was given. To acknowledge that children were normal sleeping children, detailed information about different aspects of behavioural sleep problems

(e.g., difficulties falling asleep) and about the most common childhood parasomnias (e.g., sleep terrors) were asked. Similar information was asked for the mothers. The informants were also asked about their expectations for children's sleep-wake patterns (e.g., what would be in their opinion, the *soll* time for the child to go to bed).

For study 2 and study 3, children's mothers were asked to answer the CCTQ at home and send it back by surface mail. For the kindergarten children of study 2, no other questionnaire was distributed. The additional kindergarten and school children were only included in the data analyses of Part 1 of this thesis (see above). The test-retest reliability analyses of part 1 was performed on a sub-sample of kindergarten and school children whose parents received and returned questionnaires on two occasions by surface mail. We aimed to include test-retest data of 25 kindergarten and 25 school children. Therefore, not all 57 kindergarten children of study 2 were addressed to participate in the test-retest analysis (randomly selected) while all 35 school children were addressed. All families participating in study 1 and 3 (when actigraphy data was obtained) were rewarded with a gift certificate from a book shop.

3.4. Measures

Actigraphy: Mother-child-dyads of study 1 and school children of study 3 were monitored continuously at home with an actigraph (AW4, Actiwatch Plus®, Cambridge Neurotechnology, Cambridge, UK) for 6 to 8 consecutive nights and days. An actogram of mother-child-dyad is shown in Figure 14.

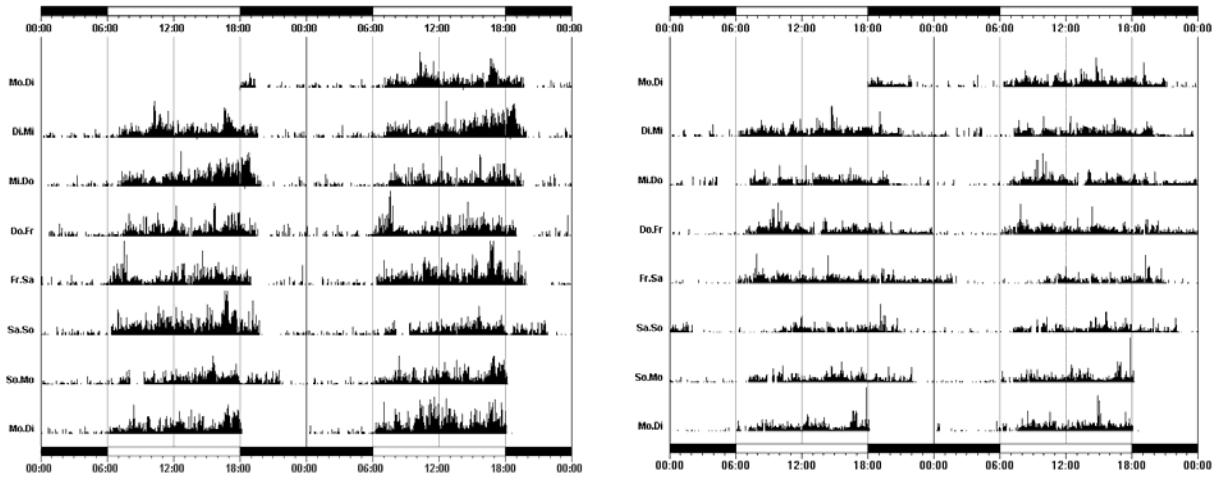

Figure 14. Actogram of a child (left side: female, 5.7 years) and a mother (right side: 36.2 years).

An actigraph is a small, wrist-worn device that contains an accelerometer to monitor the number of wrist movements per epoch (e.g., 30 or 60 seconds) and scoring algorithms are used to identify either sleep or wake from activity counts. Whether a particular epoch is scored as wake is determined by comparing activity counts for the epoch in question and those immediately surrounding it, to a threshold value set by the researcher (available thresholds: low, medium, high, automatic). Low thresholds are more specific (better able to detect wakefulness) while high threshold algorithms are more sensitive (better able to detect sleep; Paquet et al., 2007). If the number of counts exceeds the threshold, the epoch is scored as wake, if it falls below, or is equal to the threshold, the epoch is scored as sleep (Actiwatch Communication and Sleep Analysis Software, Respironics, Instruction Manual).
For example, assuming a 1-minute sampling epoch and the following activity values on/and surrounding the time 14:00:

Actigraphy scoring example

Time	13:58	13:59	14:00	14:01	14:02
Corresponding activity data	100	42	20	13	67
Total activity value			37.68		

The total activity value for the 14:00 epoch would be: 100*(1/25) + 42*(1/5) + 20 + 13*(1/5) + 67*(1/25) = 37.68. If this value is less than or equal to the wake threshold value (medium = 40) then the epoch would be scored as sleep.

Data were analysed in 1-minute epochs and translated into sleep measures by the software Actiware 5® using the scoring procedure described by Acebo et al. (2005). The scoring interval was defined as 30 minutes before the reported bedtime to 30 minutes after the reported rising time. Data were evaluated at a medium-sensitivity threshold (Actiwatch User Manual, Cambridge Neurotechnology, Cambridge, UK). Actigraphic sleep measures for the analysis included: (1) *Bed Time* as indicated in the diary; (2) *Sleep Start Time* defined as the first minute of at least 3 consecutive minutes of scored sleep within the scoring interval, (3) *Sleep End Time* as the last minute of at least 5 consecutive minutes of scored sleep just prior to the end of the scoring interval; (4) *Get up Time* as indicated in the diary as sleep end; (5) *Assumed Sleep* ("nocturnal sleep period") as the difference between Sleep Start Time and Sleep End Time; (6) *Sleep Latency* as the difference between Bed Time and Sleep Start Time; (7) *Actual Wake Time Percentage* as the percentage of the amount of time scored as wake during the nocturnal sleep period; (8) *Actual Sleep Time* ("true sleep time") as the difference between assumed sleep and the amount of time scored as wake during the nocturnal sleep period; (9) *Mid Sleep Point* defined as Sleep Start Time + Assumed Sleep/2; (10) *Number of wake bouts per hour* defined as the number of episodes of wake, whatever their length is, during the period between Sleep Start Time and Sleep End, corrected for individual's nocturnal sleep period (assumed sleep); and (11) *Motionless sleep percentage* defined as percentage of the time between Sleep Start Time and Sleep End Time the subject spent immobile or without recording any movement. According to the literature (Sadeh et al., 2000, 2001), actigraphic sleep measures were grouped in sleep quality measures and quantity measures (see Table 1). The *common sleep period* of children and mothers was defined as differences between later sleep onset times and earlier sleep end times of the mother or of the child.

Table 1. Sleep quantity and quality measures by actigraphy.

Sleep quantity measures:	*Sleep quality measures:*
- Sleep onset	- Sleep latency
- Sleep end	- Actual wake time percentage
- Assumed sleep	- Number of wake bouts per hour
- Mid Sleep Point	- Motionless sleep percentage

Actigraphs were attached to the non-dominant wrist and removed only during times when it could get wet. Children and mothers were monitored on the same days during the

academic year, including one to two weekends, but not during school vacation. Data for each actigraph measure were aggregated (averaged) over all monitored days, separately for week-days (scheduled - SC) and weekend-days (free - FR) nights, which were used as the units of analysis. All public vacation days were counted as free days. Individual actigraphy nights were discarded if the participant was sick, the actigraph was off for all or parts of the night, parents had forgotten to fill out the diary, or the diary indicated unusual external motion that would mask sleep (e.g., sleeping in the car). For the analysis of children's and mothers' sleep-wake patterns (part 3 and 4), the children and mothers had the same amount of days.

Sleep Diary: Parents completed a sleep diary (for the child and herself) on each study day when sleep was assessed by actigaphy. Diary reports were indicated in 15-minutes intervals [e.g., bedtime was indicated by a "greater sign" (>); estimated sleep start and sleep end were noted by starting and ending a continuous line; wake phases during the nights were indicated by breaks in the continuous line (see Figure 15, grey areas)]. Parents also noted any type of activity that may have influenced the scoring of actigraphic data [e.g., illness, intervals the actigraph was off of the child, car rides, see (Acebo, 2005)] and children's kindergarten time table. This diary has been used clinically at our Center for several years. Diary sleep measures for the analysis included: (1) *Bed Time* defined as indicated by a "greater sign" (>), (2) *Sleep Start* defined as the beginning of the continuous line in the evening, (3) *Sleep End* as the ending of the continuous line in the morning, (4) *Assumed Sleep* ("nocturnal sleep period") as the difference between estimated sleep start and sleep end without excluding nocturnal wake time, (5) *Nocturnal Wake Time* as the time of indicated wake time during the nocturnal sleep period, and (6) *Actual Sleep Time* as the difference between assumed sleep and nocturnal wake time. Data for each diary measure were aggregated (averaged) over all days, week-days (scheduled - SC) and weekend-days (free - FR) nights, which were used as units of analysis. All public vacation days were counted as free days. To match the amount of days and nights, individual actigraphy and diary nights were discarded in both methods if the child was sick, the actigraph was off for all or parts of the night, parents had forgotten to fill out the diary, and the diary indicated unusual external motion that would mask sleep (e.g., sleeping in the car).

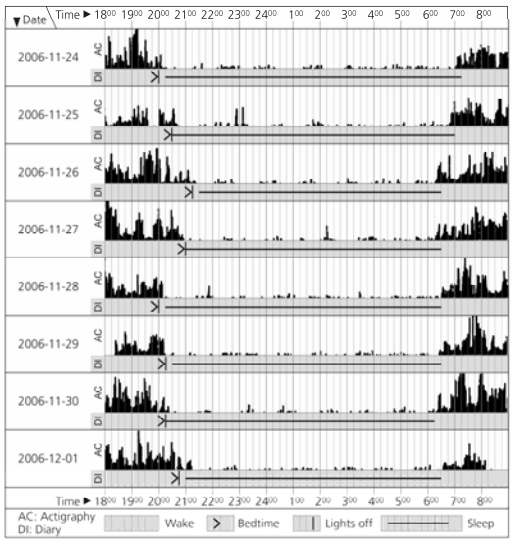

Figure 15. Actigraphy and diary data of one child (female, aged 6.1 years).

The Children's ChronoType Questionnaire (CCTQ): The CCTQ is an adaptation of the Munich ChronoType Questionnaire (MCTQ, Roenneberg et al., 2003) and the Morningness/Eveningness Scale for Children (MESC, Carskadon et al., 1993) and assesses chronotype in 4- to 11 year old children (Werner et al., 2009). The CCTQ includes a short demographics section about age, sex, birth order, family size, and education level. Parents respond to a number of open-ended questions about sleep/wake parameters for both scheduled and free days (bed time, time of lights-off, sleep latency in minutes, wake up time, get up time, time fully alert). Scheduled days (SC) are defined as those when children's sleep-wake patterns are directly influenced by individual or family activities (e.g., school, athletics). Free days (FR) are defined as those when children's sleep-wake patterns are "free" from any influence of individual or family activities. Variables derived from the CCTQ are indicated in Figure 16; computed variables included: (a) *time in bed* defined as the difference between bed time and get up time; (b) *sleep onset* defined as sleep latency added to time of lights-off; (c) *sleep period* defined as the difference between sleep onset in the evening and wake up time in the morning; (d) *sleep inertia* defined as the difference between wake up time and time being fully alert; and (e) *mid sleep point* defined as sleep onset + sleep period/2.

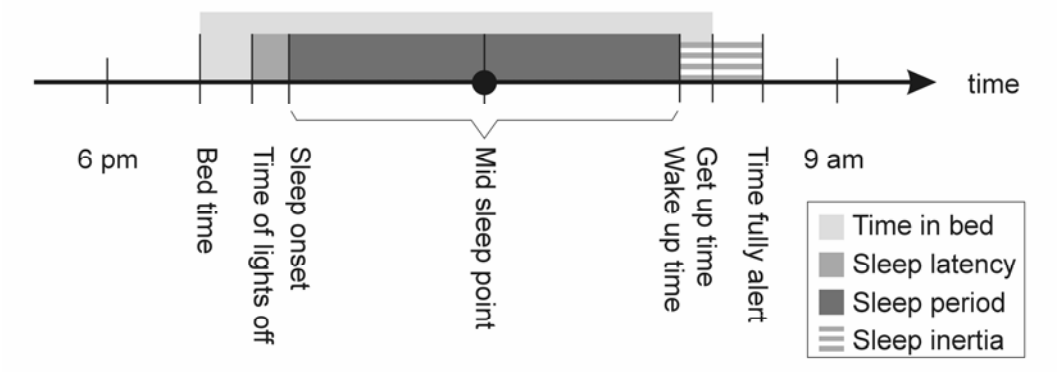

Figure 16. Parent-reported sleep/wake parameters computed from items on the Children's ChronoType Questionnaire (CCTQ).

The CCTQ includes three different parent-report measures of children's chronotype: (1) *Mid sleep point on free days (MSF)* -- the MSF is computed as the mid point of the sleep period only on free days. As many individuals compensate for a sleep deficit accumulated during scheduled days by sleeping in on free days (sleep deficit acting as a confounder for sleep period on free days), Roenneberg et al. (2004) corrected MSF for the confounding sleep deficit based on the individual weekly average sleep need (*MSFsc; see also MCTQ*); (2) *Morningness/Eveningness (M/E)* -- the M/E scale score is derived from responses to 10 questions (see Appendix items 17-26) about preferred timing of going to bed, getting up in the morning, taking a cognitive test, and doing physical activities, as well as the child's most prevalent behaviour in recent weeks (e.g., sleepiness after awakened in the morning and in the evening). M/E scale-scores range from 10 (extreme morningness) to 49 (extreme eveningness). Morning-types are classified by a M/E scale score of ≤ 23, intermediate-types by a score of 24-32, and evening-types by a score ≥ 33. Cronbach's Alpha for the 10 items (.81) was similar to that for the adolescent version of Carskadon and colleagues (1993); corrected item-total correlations were on average .49 and ranged from .31 to .71. (3) *Chronotype (CT)* -- the CT is a single item measure. Parents read a short description of different chronotypes and select one of five categories that best represent their child's circadian phase preference (i.e., definitely a morning type, rather a morning type than an evening type, neither nor type, rather an evening type than a morning type, or definitely an evening type). CT scores range from 1 (definitely a morning type) to 5 (definitely evening type). This measure has been widely used in sleep and circadian research (e.g., Horne & Östberg, 1976; Roenneberg et al., 2003) with response set varying from 3 to 7 categories.

The Munich Chronotype Questionnaire (MCTQ): The MCTQ (Roenneberg et al., 2003) assesses actual sleep timing by self-report separately for scheduled and free days (e.g., bed time, sleep latency, time fully alert) and estimates individual's circadian preference by a single phase-reference point, the mid-sleep point on free days (MSF). Scheduled days (SC) are defined as those days when individual's sleep-wake patterns are directly influenced by individual's activities, whereas free days (FR) are defined as those when sleep-wake patterns are "free" from any influence of social zeitgebers (e.g., work). Computed variables included: (a) *sleep onset* defined as sleep latency added to bedtime; (b) *sleep period* defined as the difference between sleep onset in the evening and get up time in the morning; (c) *time in bed* defined as the difference between bed time and get up time; (e) *sleep inertia* defined as the difference between get up time and time being fully alert; (f) *mid sleep point* defined as Sleep Onset + Sleep period/2. As many individuals compensate for a sleep deficit accumulated during scheduled days by sleeping in on free days (sleep deficit acting as a confounder for sleep period on free days), Roenneberg and colleagues corrected MSF for the confounding sleep deficit based on the individual weekly average sleep need (*MSFsc*). The average sleep need is defined as (5*sleep period on scheduled days + 2*sleep period on free days)/7 [for correction algorithm for MSF, see supplement to Roenneberg et al. (2004)]. Additionally to this quantitative assessment of individual's circadian preference, the MCTQ includes a qualitative assessment of chronotype by asking respondents to rate themselves as one of seven categories that best represent their circadian phase preference (extreme early, moderate early, slightly early, normal, slightly late, moderate late, extreme late). For this study, the 7-point likert scale was adapted to a 5-point likert scale CT score (see CCTQ). The validity of the MSF as a individual's chronotype measure in adults and adolescents is evidenced by strong concordance with the Morningness-Eveningness Questionnaire scores (MEQ, Horne & Östberg, 1976; MSF: r=-.73, Zavada et al., 2005) and with the Composite Scale of Morningness scores (CSM, Smith et al., 1989; MSF: r=-.62, Randler, 2008). The self-report MCTQ has been used in adults, adolescents, and children as young as 10 years of age (Roenneberg, Date accessed: 12.11.08).

Interview: The informants were asked about different aspects of behavioural sleep problems (e.g., struggles at bedtime, difficulties falling asleep, night waking) and about the most common childhood parasomnias (e.g., sleep terrors, sleep walking). The questions were phrased as follows: 1) "does your child normally resist or delay going to bed?", 2) "does your child normally have difficulties falling asleep?", 3) "does your child normally wake up during

the night?", 4) "does your child complains of a sudden episode of intense terror during sleep within the first third of the night?", and 5) "does your child has sleep walking episodes?". Responses were rated by the interviewer as "no" if normally no sleep problems occurred/week, "rarely" if sleep problems occurred once to twice/week, "sometimes" for three to four times/week, and "often" for five to seven times/week. Furthermore, each behaviour was rated by the informants whether they consider that their child would have a sleeping problem which cause distress and conflict on a 5-point likert scale ranging from very slightly (1) to extremely distressed (5) (Morrell, 1999). Except for the aspects of childhood parasomnias, the same information was assessed for the mothers. Information was also obtained for the time of assessment and the past four weeks regarding daytime napping, medication, physical complaints, and surgical interventions (yes/no).

Children's and mothers' sleep quality (SQ) was rated by the mothers on a 10-point likert scale ranging from very bad (1) to very good (10). The question was phrased as "how would you rate the quality of your sleep/child's sleep overall?". The SQ scale is derived from the Kidney Disease Quality of Life Short Form (KDQOL-SF-36; Hays et al., 1994). Hays et al. (1995) considered a SQ score < 6 as poor sleep quality and a score ≥ 6 as good sleep quality.

Parental expectations for children's sleep-wake patterns were assessed by asking the informants about children's *soll* sleep-wake patterns: what would be, in their opinion, the *soll* time for the child to go to bed, put off lights, and get up. Furthermore informants were asked about *soll* sleep period and *soll* sleep latency. Except for *soll* sleep latency, the *soll* sleep-wake patterns were also asked separately for scheduled and free days (for definitions of scheduled and free days see CCTQ or MCTQ). Computed variables included: (a) *soll sleep onset* defined as *soll* sleep latency added to *soll* bedtime; (b) *soll time in bed* defined as the difference between *soll* bed time and *soll* get up time; and (c) *soll mid sleep point* defined as *soll* sleep onset + *soll* sleep period/2. As sleep is primarily defined by endogenous components, bigger differences between *soll* and *ist* sleep times (CCTQ) would indicate less appropriate parental expectations.

Socioeconomic Status: Socioeconomic status (SES) was estimated by means of a sum score of two strictly defined six-point scales of paternal occupation and maternal education. The scale of paternal occupation ranging from non-skilled (1) to highly skilled is including an occupation with a university degree (6). The scale of maternal education ranged from non attendance of the obligatory school time (1) to university degree (6). The sum scores ranged

from 2 (lowest socioeconomic status) to 12 (highest socioeconomic status). Three social classes were defined as follows: SES scores 2 to 5, lower class; SES scores 6 to 9, middle class; SES scores 10 to 12, upper class. This measure has been used in previous studies and has been shown to be a reliable and valid indicator of SES in our community (Largo et al., 1989; Seitz et al., 2006).

Pubertal development: All school children were assessed by the self-rating scale for pubertal development (Carskadon et al., 1993). The scale is an adaptation of the interview-based puberty rating scale by Peterson (Peterson, 1984), including five items for rating physical development, an overall maturation measure, and a categorical maturation score designed to be similar to Tanner staging categories (Tanner, 1962). The puberty scores are categorized separately for girls and boys as 1) pre-pubertal, 2) early pubertal, 3) mid-pubertal, 4) late pubertal, and 5) post-pubertal. Children with a pubertal score ≥ 3 were excluded from the data analysis, because sleep regulatory mechanisms change during the course of puberty (Carskadon et al., 1993).

Parental Distress (PSI-SF): Mothers' parenting stress with the given kindergarten child was assessed by the PSI-SF (Abidin, 1995), a 36-item self-report measure and direct derivative of the Parenting Stress Index full-length. Although the full-length PSI examines the parent-child dyad more closely and is constructed to identify parent-child systems under stress and at risk for dysfunctional parenting or deviant behaviour, the 3 factors of the short-form (based on a factor-analysis of the full-length; (Castaldi, 1990) appear to capture the primary components of parenting stress by focusing on the parent, the child, and their interactions (Abidin, 1995). High correlations between short and full-length form (r = .87 - .93; Abidin, 1995) indicate good internal validity. The PSI-SF includes 3 subscales and a sum scale 'total stress' which all may be considered separately. The *Parent Distress* (PD) subscale reflects the parents' perception of child-rearing competence and indicates the level of distress resulting from personal factors (e.g., depression or life restrictions due to the demands of child-rearing). The *Parent-Child Dysfunctional Interaction* (P-CDI) subscale assesses the parents' perception that the child does not meet expectations and provides an indication of parents' dissatisfaction with interactions with their children. The *Difficult Child* (DC) subscale measures a parents' perception of the child's temperament, demandingness and non-compliance. The 3 subscales consist of 12 items each and parents use a 5-point scale to indicate the degree to which they agree with each statement. The scores of these 3 subscales are summed to *„Total Stress"* (TS)

which is designed to give an overall level of parenting stress and should be never interpreted as anything more than as an indication of the stress level experiences within the role of the parent (Abidin, 1995). The raw scores are converted into percentile scores and parents who obtain a Total Stress score above the 90 percentile are experiencing clinically significant levels of stress and should be referred for professional assistance. Furthermore, the PSI-SF includes a *Defensive Responding Scale* that indicates the degree to which a parent might be attempting to deny or minimize problems in the parent-child relationship (Abidin, 1995). A variety of validity indicators have been used to examine construct validity of the PSI-SF [e.g., Symptom Check List (SCL-90-R; Derogatis & Melisaratos, 1983), Child Behavior Check List (CBCL; Achenbach, 1991), Parent Perception of Child Adjustment (Eyberg & Piacus, 1999)]. For instance high levels of parental distress were related to poor overall emotional health on the SCL-90-R (PD: r = .54; TS: r = .56), children's externalizing behaviour was most strongly associated with the DC subscale, and parents who reported difficulty with their child's regulatory capacity and demandingness on P-CDI and DC viewed their child's adjustment as highly problematic on the ECBI (P-CDI and DC subscales together: r = .61, Total Stress: r = .55; (Hart & Kelly).

Life Event List (LEL): A list of 17 life events about changes in the work and financial situation, about events focused on separation, divorce, marriage and death were selected from pre-existing questionnaires on life events (Paykel et al., 1980; Sarason et al., 1978; Steinhausen & Winkler Metzke, 2001). The time frame was defined as the twelve months prior to filling out the questionnaire. Beside the frequencies of life events (0-17), a total impact score was calculated. This was based on a scale attached to each item by asking the informants about the perceived distress on a 5-point likert scale, ranging from 1 (mild) to 5 (severe).

Temperament Inventory (EAS): The EAS temperament inventory (Buss & Plomin, 1984) measures the four dimensions of temperament by parent-report: (1) *Emotionality* – the tendency to become aroused easily and intensely, (2) *Shyness* – the tendency to be inhibited and awkward in new social situations (3) *Sociability* – the tendency to prefer the presence of others to being alone, and (4) *Activity* – preferred levels of activity and speed of action. The EAS is a 20-item questionnaire for 1-to 9 year old children with 5 corresponding items to each of the 4 temperament dimensions. A 5-point rating scale is used ranging from (1) not characteristically or typical of your child to (5) very characteristically or typical of your child.

The scores from the questions belonging to each dimension are summed to form the four temperament indicators. Even within a large age range, the EAS proved to be a reliable instrument, yielding satisfying internal consistencies and good interrater agreement (DePauw et al., 2009; Spinath, 2001). However, Boer and Westernberg (1994) found in a sample of Dutch children between 4 and 12 years that a four-factor solution did not separate the dimension Sociability from Shyness and Activity. Scale inter-correlations and factor analyses indicate that Emotionality, Activity, and Shyness are relatively independent, whereas Sociability is significantly related to both Shyness and Activity (Boer & Westenberg, 1994). Furthermore, in spite of high stability across time, there were also significant age effects (Mathiesen & Tambs, 1999) for all four temperament dimensions, in the sense that children became more emotional and shy with increasing age, while mean scores of Activity and Sociability decreased. Temperament researchers (e.g., Masi et al., 2003; Rende, 1993) document strong links between emotionality and shyness/social inhibition and the development of internalizing problems.

3.5. Statistical Analyses

Descriptive results are presented as means and standard deviations (SD). Mean differences between week-days (SC) and weekend-days (FR) were examined using Students *t*-tests for dependant samples. Pearson and Spearman correlations, simple and quadratic regression and analysis of variance were used to describe the relationship between sleep-wake patterns and various other variables (e.g., age, sex, birth order, and type of day). All analyses were performed with two-tailed tests, and $p < 0.05$ was considered significant. SPSS (14.0J for Windows; SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

The following statistical analyses were performed in detail:

Part 1: Reliability and Validity of the CCTQ.

Because parents commonly reported their children's sleep-wake times to the nearest full-hour or half-hour rather than to the nearest minute (e.g., 8:15 p.m., rather than 8:07 p.m. bedtime), many variables from the CCTQ had significant skewness and/or kurtosis. As a consequence, we used nonparametric tests for all parameters for testing equality of means (Wilcoxon-Test) and Spearman correlations to measure associations. Effect size in SD units (Cohen's d) was computed for actigraphy and questionnaire mean (M) comparisons and for scheduled and free days mean (M) comparisons ($d = M_{sample\ 1} - M_{sample\ 2}/SD_{pooled}$) (Cohen,

1962). Test-retest reliability coefficients were determined with Pearson correlations, except for the chronotype measure CT, which was assessed with Spearman correlations.

Part 2: Limits of Agreement.

The degree of agreement between different methods (actigraphy, diary, questionnaire) was quantified using the 95% limits of agreement by Bland and Altman, estimated by mean difference ± 1.96 standard deviation of differences (Bland & Altman, 1986, 1999). Simple regression and ANOVA were used to describe the relationship between sleep parameters and demographic variables (age, sex, SES).

Part 3: Children's and mothers' sleep-wake patterns assessed by actigraphy.

Reliability estimates for monitored actigraphy days were assessed by Intraclass Correlations (ICC; two-way random effects model ANOVA, average measure). Mean differences between scheduled and free days as well as between children and mothers were analyzed by two-way analysis of variance for repeated measures. Night-to-night variability of children's and mothers' sleep scheduled and quality variables was computed by the Coefficient of Variation (CV) - defined by the ratio of the standard deviation to the mean (SD/M*100). Canonical correlations (multivariate method) were used to measures associations between two sets of variables (e.g., several sleep quality variables of the mothers and children). To define minute-by-minute agreement between children's and mothers' sleep/wake score (S/W) computed by the software Actiware5® , sleep-wake scores for each minute were imported to SPLUS and common wake phases > 5 minutes were extracted.

Part 4: Are children's and mothers' sleep-wake patterns related to parental distress?

As a consequence that many MCTQ variables (see also Part 1) had significant skewness and/or kurtosis, we used nonparametric tests for all parameters for testing equality of means (Wilcoxon-Test) and Spearman correlations to measure associations between sleep-wake patterns and PSI-SF scores. Moreover, linear regression models were set up using temperament scores, children's sex, mothers' sleep quality score and *ist/soll*-differences for time of lights off as independents. The independent variables were chosen on the basis of significant univariate correlations found in earlier sections.

4. Results

4.1. Part 1: Validity and Reliability of the CCTQ.

This part summarizes the results indicated in Werner et al. (2009).

4.1.1. Included Participants

Children were recruited as part of three individual studies (study 1, 2 and 3) of the ZCSS (see Figure 13). In the first two studies, researchers recruited 135 children from 39 of 270 Zurich kindergartens. Of these children, 117 children were enrolled and included in the data analysis. The first study was carried out in 2006/2007 (see Werner et al., 2008), and the second and third study was completed in 2007/2008. In the third study, 46 children were recruited from primary schools in the greater Zurich area and from a special school program for gifted children; thirty-five of these children were included in this analysis (n=19 recruited from primary schools; n=16 recruited from school program for gifted children). In total, parents of 181 children agreed to participate after initial contact and 152 children were selected for the analysis [75 girls and 77 boys, mean age 6.70 ± 1.5 (SD) years, range = 4-11 years]. At time of assessment, 80 children (53%) were the eldest sibling or an only-child, and 72 children (47%) had an older sibling. None of the children took regular naps.

Overall, 29 children were excluded because (1) parents had insufficient language skills or the questionnaire was not filled out completely (n=12); (2) several families reported data for two or more children, but only one child was included in the data analysis based upon random selection (n=16); and (3) children had a self-reported pubertal development score ≥ 3 (n=1; Carskadon et al., 1993). The actigraphic validity analysis included data from a sub-sample of 85 children (50 kindergarten and 35 primary school children). The test-retest reliability analysis was performed on a sub-sample of 43 children.

4.1.2. Parental reports of children's sleep/wake parameters on scheduled and free days

Descriptive statistics for sleep/wake parameters are shown separately for scheduled and free days in Table 2 (parameters are illustrated in Figure 16). Mean differences between scheduled and free days were significant for all sleep/wake parameters (Table 2). On free days, children went to bed later and got up at later times, slept about 20 minutes longer, and had shorter sleep latencies and sleep inertia estimates than on scheduled days.

Because age is a predictor of many sleep/wake parameters, age effects were examined by simple regression [Table 2 reports coefficients of age with standard error (SE)]. Results indicate that older children went to bed later, had later sleep onsets, had shorter sleep periods and spent less time in bed than younger children. Sleep latency and sleep inertia on both types of day (SC, FR) were not influenced by age. Wake up time, get up time, and time fully alert were later for older children on free days only. After controlling for age, girls had longer sleep latencies and woke up later than boys ($p < .05$). Sleep/wake parameters were not associated with birth order.

Table 2. Descriptive statistics for parent-reported sleep/wake parameters on scheduled and free days from the Children's ChronoType Questionnaire (CCTQ) and linear regression coefficients by age (n=152).

	Scheduled Days[a]	Free Days[a]	Statistics	Scheduled Days[b]	Free Days[b]
Bed time	20:17 (0:31)	20:47 (0:46)	$p < 0.001$, $d = 0.77$	0:09 (0:01) †	0:16 (0:02) †
Time of lights off	20:35 (0:36)	21:02 (0:48)	$p < 0.001$, $d = 0.66$	0:11 (0:02) †	0:18 (0:02) †
Sleep latency	0:12 (0:09)	0:11 (0:10)	$p \leq 0.001$, $d = 0.07$	0:01 (0:00:29)	
Sleep onset	20:47 (0:38)	21:13 (0:50)	$p < 0.001$, $d = 0.59$	0:13 (0:02) †	0:19 (0:02) †
Wake up time	7:07 (0:25)	7:51 (0:46)	$p < 0.001$, $d = 1.23$	-0:01 (0:01)	0:09 (0:02) †
Get up time	7:16 (0:25)	8:00 (0:48)	$p < 0.001$, $d = 1.20$	-0:00:04 (0:01)	0:11 (0:02) †
Time fully alert	7:29 (0:36)	8:05 (0:53)	$p < 0.001$, $d = 0.81$	-0:01 (0:02)	0:10 (0:03) †
Sleep period	10:20 (0:40)	10:38 (0:45)	$p < 0.001$, $d = 0.43$	-0:11 (0:02) †	
Time in bed	10:59 (0:34)	11:14 (0:47)	$p < 0.001$, $d = 0.37$	-0:10 (0:02) †	-0:05 (0:02) †
Sleep inertia	0:22 (0:23)	0:14 (0:20)	$p < 0.001$, $d = 0.33$	0:01 (0:01)	
Mid sleep point	1:58 (0:26)	2:32 (0:43)	$p < 0.001$, $d = 1.00$	0:06 (0:01) †	0:14 (0:02) †
MSFsc	2:26 (0:40)			0:13 (0:02) †	

[a] Reported as mean (standard deviation), in hours : minutes.

[b] Reported as slope coefficient (standard error). When no interaction between age and type of day (scheduled versus free) existed, the common slope was reported (Analysis of Covariance); otherwise separate slopes are reported.

† Significant effect of age ($p \leq .05$).

4.1.3. Children's chronotype measures

MSF and MSFsc did not show any significant deviation from a normal Gaussian distribution. Although statistically significant ($p < .001$), MSF and MSFsc means differed by only 6 minutes [.10 hours; MSF = 2.53 (.71) versus MSFsc = 2.43 (.67)], with a small effect size ($d = .15$). MSF and MSFsc were both significantly related to children's age (older children had later MSFs) and sex (girls have later MSFs than boys), but not to birth order. The

distribution of the M/E score did not show any significant deviation from normality, with a mean of 28.2 (SD = 6.0; range = 15 to 43). The M/E score was not associated with age, sex or birth order. The distribution of the CT is presented in the inlet of Figure 2. Thirty-nine parents (26%) classified their children as definitely morning type, 30 (20%) as rather morning type than evening type, 23 (15%) as neither nor type, 35 (23%) as rather evening type than a morning type, and 21 (14%) as definitely evening type. Age, sex and birth order were not related to CT.

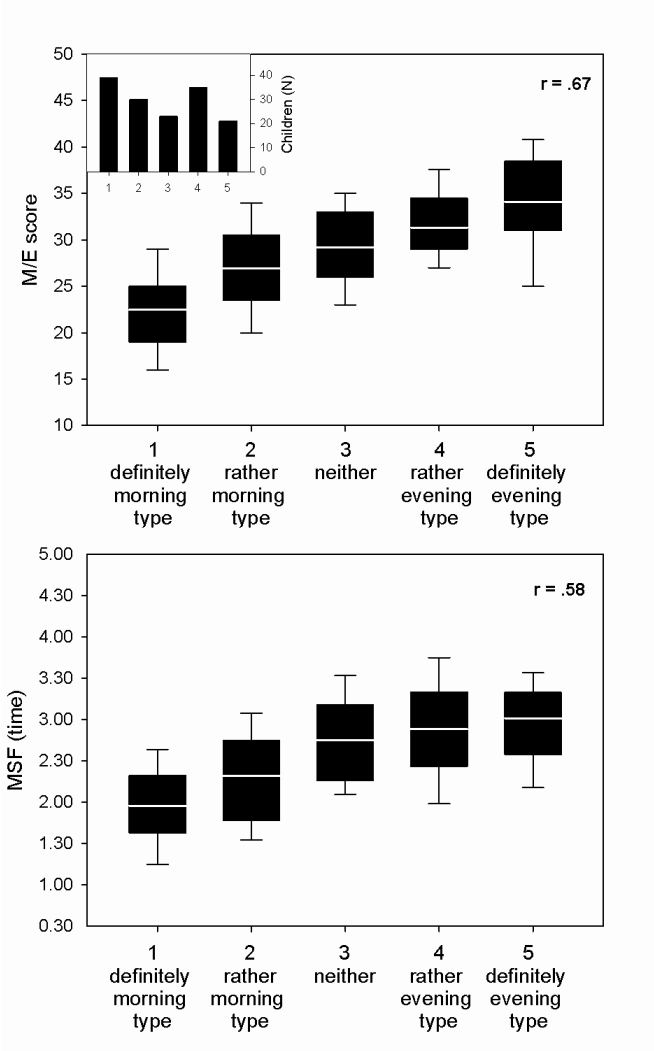

Figure 17. Distribution of ChronoType (CT) scores (upper left insert) and associations with Morningness/Eveningness (M/E) scores and mid sleep point on free days (MSF).
Note: White line within the boxes: median; Lower/upper border of the boxes: interquartile range.

4.1.4. Concordance between parental-report of sleep/wake parameters and chronotype measures

Validity of the three measures of children's chronotype was first examined by determining concordance with sleep/wake parameters (see Table 3). All three measures of children's chronotype were significantly related to time going to bed, time of lights off, sleep latency, sleep onset, wake up time, get up time, and time fully alert. Across chronotype measures, the highest correlations were with MSFsc [e.g., for sleep onset (r=.93) and time of lights-off (r=.92) on free days]. Later chronotypes had later sleep start times, later get up times, and later times to be fully alert. While chronotype as measured by M/E or CT was not related to sleep period on scheduled or free days, chronotype as measured by MSF was related to sleep period on scheduled days (r=-.37), and MSFsc was related to sleep period on both type of days (SC: r=-.32; FR: r=-.24).

As shown in Table 2, children significantly delayed their sleep/wake patterns from scheduled to free days (e.g., bedtime for 30 minutes; get up time for 44 minutes) and slept on average 18 minutes longer on free days than scheduled days. We found a positive correlation between the difference in sleep period on scheduled and free days with children's chronotype. Earlier chronotypes extended their sleep period less on free days than later chronotypes (MSF: $r = .33$, $p < .001$; M/E-score: $r = .32$, $p < .001$; CT: $r = .29$, $p < .001$). The difference between sleep period on scheduled and free days was not related to MSFsc ($r = .04$, $p \geq .05$). Furthermore, later chronotypes (all three chronotype measures) had longer sleep inertia on scheduled days, and later chronotypes (M/E and CT measures) reported a longer time in bed on free days than earlier chronotypes (see Table 3).

Table3. Spearman correlations between parent-reported sleep/wake parameters and mid sleep point on free days (MSF), corrected mid sleep point on free days (MSFsc), morningness/eveningness (M/E) scores and chronotype (CT) scores (n=152).

		MSF	MSFsc	M/E-score	CT
Bed time	SC	0.59*	0.57*	0.33*	0.23*
	FR	0.76*	0.82*	0.31*	0.31*
Time of lights off	SC	0.68*	0.64*	0.43*	0.36*
	FR	0.86*	0.92*	0.40*	0.40*
Sleep latency	SC	0.31*	0.31*	0.23#	0.29*
	FR	0.18#	0.19#	0.25#	0.29*
Sleep onset	SC	0.70*	0.66*	0.46*	0.41*
	FR	0.87*	0.93*	0.42*	0.45*
Wake up time	SC	0.46*	0.45*	0.52*	0.40*
	FR	0.89*	0.75*	0.63*	0.59*
Get up time	SC	0.51*	0.47#	0.55*	0.41#
	FR	0.87*	0.75*	0.63*	0.57*
Time fully alert	SC	0.53*	0.48#	0.68*	0.50*
	FR	0.82*	0.69*	0.66*	0.59*
Sleep period	SC	-0.37*	-0.32*	-0.12	-0.18
	FR	-0.05	-0.24#	0.16	0.13
Time in bed	SC	-0.16	-0.16	0.11	0.06
	FR	0.08	-0.09	0.29#	0.22#
Sleep inertia	SC	0.28*	0.21#	0.45*	0.27*
	FR	-0.00	-0.03	0.28*	0.10
M/E-score		0.584*	0.516*		0.672*
CT		0.581*	0.524*	0.672*	

Note: Correlation coefficients are reported for scheduled (SC) and free (FR) days.

* $p \leq .001$

$p \leq .05$

4.1.5. Relations between chronotype measures

The three different measures of the children's chronotype were significantly correlated (r = .52 to r= .67; Table 3). Figure 2 illustrates monotonic relationships between CT and the two other chronotype measures (MSF and M/E). While the association between M/E and CT appears to be linear, the association between MSF and the CT suggests a levelling off in the two evening classes (moderate and definitely).

4.1.6. Parent-reported and actigraphically-estimated sleep/wake parameter comparisons

On a sub-sample of 85 children, parent-reported sleep/wake parameters were compared to measures derived from actigraphy (Table 4). On average, parents reported significantly earlier sleep onsets, later wake up times, and longer sleep periods than estimated by actigraphy. Discrepancies between the two measures (e.g., earlier parental report of sleep onset time and later parental report of wake time as computed by actigraphy) were on average approximately the same. Thus, the finding of no significant differences in mid sleep point on scheduled and free days was not surprising. Parental reports of sleep latency were significantly shorter than corresponding actigraphic estimates. In contrast, MSFsc computed from actigraphic measures was 12 minutes later than from the CCTQ ($p = .006$, $d = .27$).

Table 4. Comparison of actigraphic estimates of sleep/wake parameters and corresponding parent reports from the Children's ChronoType Questionnaire (CCTQ; n=85).

	Actigraphy		CCTQ		Statistics	
	Scheduled Days[a]	Free Days[a]	Scheduled Days[a]	Free Days[a]	Scheduled Days*	Free Days[#]
Bed Time / Time of Lights-Off	20:49 (0:43)	21:31 (0:57)	20:41 (0:40)	21:13 (0:55)	$p < 0.01$, $d = 0.19$	$p < 0.001$, $d = 0.32$
Sleep Start / Sleep onset	21:08 (0:42)	21:51 (0:56)	20:55 (0:43)	21:25 (0:58)	$p < 0.001$, $d = 0.32$	$p < 0.001$, $d = 0.46$
Sleep End / Wake up time	7:00 (0:26)	7:42 (0:44)	7:08 (0:28)	7:57 (0:50)	$p < 0.01$, $d = 0.29$	$p < 0.001$, $d = 0.32$
Assumed Sleep / Sleep period	9:49 (0:38)	9:55 (0:40)	10:13 (0:43)	10:32 (0:50)	$p < 0.001$, $d = 0.59$	$p < 0.001$, $d = 0.83$
Sleep Latency	0:20 (0:11)	0:20 (0:14)	0:14 (0:10)	0:12 (0:11)	$p < 0.001$, $d = 0.56$	$p < 0.001$, $d = 0.68$
Mid Sleep Point	2:03 (0:31)	2:48 (0:47)	2:01 (0:29)	2:40 (0:48)	NS	NS
MSFsc	2:46 (0:47)		2:34 (0:46)		$p < 0.01$, $d = 0.27$	

[a] Reported as mean (standard deviation), in hours : minutes.

* *Wilcoxon* Signed-Rank -Test between actigraphy and questionnaire data for scheduled days.

[#] *Wilcoxon* signed-Rank -Test between actigraphy and questionnaire data for free days.

Note: NS = not significant.

4.1.7. Concordance between actigraphic estimates of sleep/wake parameters and chronotype measures

Validity of chronotype measures was also assessed by examining concordance between actigraphically estimated sleep/wake parameters (SC and FR) and the three chronotype measures. Spearman correlations are presented in Table 5. Independent of type of day (SC, FR), later chronotypes had later bedtimes, sleep start times, and sleep end times. Sleep latency as assessed by actigraphy was not significantly related to any parent-report measure of children's chronotype. Assumed sleep assessed by actigraphy was negatively related to the MSF and MSFsc, but not to M/E or CT. Concordance between parent-reported and actigraphically estimated MSF was high (r = .78; for MSFsc: r = .70)

Table 5. Spearman correlations between actigraphic estimates of sleep/wake parameters and parent reports of mid sleep point on free days (MSF/MSFsc), morningness/eveningness scale (M/E) scores, and chronotype (CT) scores (n=85).

Actigraphy		Children's ChronoType Questionnaire (CCTQ)			
		MSF	MSFsc	M/E	CT
Bedtime	SC	0.70*	0.72*	0.39*	0.30#
	FR	0.74*	0.74*	0.44*	0.40*
Sleep latency	SC	0.05	-0.03	0.003	0.01
	FR	-0.04	-0.05	0.09	0.15
Sleep Start	SC	0.70*	0.70*	0.41*	0.32#
	FR	0.75*	0.74*	0.45*	0.43*
Sleep End	SC	0.46*	0.45*	0.45*	0.34#
	FR	0.64*	0.56*	0.65*	0.51*
Assumed Sleep	SC	-0.49*	-0.51#	-0.10	-0.10
	FR	-0.31#	-0.38*	0.05	0.00
Mid Sleep Point	SC	0.67*	0.66*	0.50*	0.37*
	FR	0.78*	0.73*	0.57*	0.50*
MSFsc		0.73*	0.70*	0.52*	0.47*

Note: SC = scheduled days; FR = free days.

* $p \leq .001$

$p \leq .05$

4.1.8. Test-retest reliability

The CCTQ was administered twice within 2-4 weeks (range between the two administrations: 14 - 37 days, mean=20 days) to parents of 46 children (23 girls, 50%) who were on average 7.7 years old (range: 4.4-11.0 years). Standard deviations for the sleep/wake parameters of the first and second administration were approximately the same, and mean differences between the two administrations were not significant for any parameter ($p > .05$). The reliability was moderate-to-high for most sleep/wake parameters ($r = .58$ to $r = .94$, Table 6) and high for the three chronotype measures [$r = .91$ ($p < .001$) for MSF; $r = .79$ ($p < .001$) for MSFsc; $r = .94$ ($p < .001$) for M/E; and $r = .84$ ($p < .001$) for CT]. The time between the two administrations and whether the questionnaires had been filled out on the same type of day (e.g., both on scheduled, or free) did not significantly influence differences between the two administrations.

Table 6. Test- Retest Reliability (Pearson correlations) within 2-4 weeks for parent-reported sleep/wake parameters, mid-sleep point on scheduled and free days, and corrected mid sleep point on free days (MSFsc; n=46).

	Scheduled days	Free days
Bedtime	0.90	0.88
Time of lights-off	0.90	0.85
Sleep latency	0.74	0.58
Sleep onset	0.92	0.85
Wake up time	0.89	0.91
Get up time	0.91	0.91
Time fully alert	0.94	0.89
Sleep period	0.94	0.79
Time in bed	0.92	0.82
Sleep inertia	0.78	0.70
Mid Sleep Point	0.87	0.91
MSFsc	0.79	

All correlations are $p \leq .001$.

Note: Reliability coefficients for M/E and CT are presented in the text.

4.2. Part 2: Limits of Agreement.

This part summarizes the results indicated in Werner et al. (2008).

4.2.1. Included Participants

Children were recruited from 34 of 270 kindergartens, sequentially from May 2006 until July 2007. Fifty of the 63 children (79%) were included in the final data analysis [28 boys (56%) and 22 girls (44%); mean age at time of assessment was 5.9 years (range 4.5 to 7.3)]. The children were mostly from two-parent families (mean SES = 9.6, range 6 to 12), with 50% in middle and 50% in upper class socioeconomic status; lower class was not represented. Forty-four children (88%) lived with both parents and only 6 children (12%) with only one of the parents. Additional sample characteristics are presented in Table 7. None of the children took regular naps.

Overall, 13 of the 63 families were dropped from the study for a variety of reasons: (*a*) deregistration (n=1); (*b*) parents had two kindergarten children, of which both children took part in the study, but only one child was included in the data analysis based upon radom selection (n=3); (*c*) child's refusal to wear the actigraph (n=3); (*d*) technical problems (n=4); and (*e*) actimeter loss (n=2).

Table 7. Sample Characteristics.

	Range	M (SD)	% of sample
No. of children per family	1-4	2.2 (0.8)	
1 child			14%
2 children			60%
3 children			18%
4 children			8%
Birth order of child	1-3	1.5 (0.7)	
Of which first born			60%
Age of children	4.5-7.3	5.9 (0.7)	
Age of mothers	29-49	38.6 (4.4)	
Nationality of parents			
both parents Swiss			62%
only one parent Swiss			30%
both parents Non-Swiss			8%
Employment of parents			
mother and father employed			58%
father employed			36%
mother employed			6%
Kindergarten duration/day		3:42h (0:30h)	

4.2.2. Overview of sleep variables assessed by the different methods (QU, DI, and AC)

Mean (SD) of sleep start, sleep end, assumed sleep, actual sleep time, nocturnal wake time, and mid sleep point assessed by the different methods are presented in Table 8. Children delayed their sleep start, sleep end and mid sleep point from week-days to weekend-days only about half an hour, but did not significantly sleep longer on weekends, although some inconsistencies exist between the different measures.

Table 8. Overview of sleep variables assessed by actigraphy, diary, and questionnaire. All times in hours and minutes.

	Actigraphy				**Diary**				**Questionnaire**			
	all days	week-days	weekend-days	P-Value*	all days	week-days	wekend-days	P-Value*	all days	week-days	wekend-days	P-Value*
Sleep start	21:00 (0:39)	20:54 (0:42)	21:24 (0:48)	<0.001	20:48(0:42)	20:46 (0:42)	20:54 (0:42)	0.363	x	20:42(0:42)	21:00 (0:54)	<0.001
Sleep end	7:12 (0:30)	7:00 (0:30)	7:36 (0:48)	<0.001	7:18 (0:24)	7:18 (0:30)	7:24 (0:36)	0.208	x	7:12 (0:36)	7:54 (0:54)	<0.001
Assumed sleep	10:12 (0:30)	10:06 (0:30)	10:12 (0:36)	0.328	10:30 (0:30)	10:30 (0:30)	10:30 (0:42)	0.917	x	10:30 (0:42)	10:54 (0:42)	<0.001
Actual sleep time	8:42 (0:36)	8:36 (0:42)	8:46 (0:42)	0.070	10:24 (0:30)	10:24 (0:31)	10:24 (0:36)	0.980	x	x	x	x
Nocturnal wake time	1:29 (0:26)	1:30 (0:29)	1:36(0:26)	0.423	0:02 (0:06)	0:02 (0:06)	0:02 (0:06)	0.634	x	x	x	x
Mid Sleep Point	2:06 (0:32)	1:56 (0:31)	2:29 (0:44)	<0.001	2:07 (0:32)	2:05 (0:34)	2:11 (0:40)	0.333	x	1:55 (0:34)	2:25 (0:49)	<0.001

* paired *t*-test between weekdays and weekend-day

Table 9. Pearson correlation coefficients between sleep variables assessed by actigraphy, diary, and questionnaire and children's school start.

	Actigraphy	Diary	Questionnaire
	r (P-Value)	r (P-Value)	r (P-Value)
Sleep Start, *week-days*	.15 (.298)	.14 (.330)	.13 (.366)
Sleep Start, *weekend-days*:	.10 (.489)	.04 (.773)	.03 (.866)
Sleep End, *week-days*	.28 (.046)	.31 (.029)	.35 (.007)
Sleep End, *weekend-days*	.25 (.085)	.18 (.225)	.14 (.354)
Assumed Sleep, *week-days*	.08 (.598)	.11 (.459)	.14 (.317)
Assumed Sleep, *weekend-days*	.17 (.237)	.12 (.428)	.20 (.173
Actual sleep time, *weekdays*	.15 (.315)	.04 (.769)	x
Actual sleep time, *weekend-days*	.23 (.104)	.07 (.640)	x
Nocturnal wake time, *weekdays*	-.11 (.432)	.28 (0.52)	x
Nocturnal wake time, *weekend-days*	-.12 (.419)	.11 (.453)	x
Mid Sleep Point, week-days	.23 (.107)	.23 (.106)	.27 (.054)
Mid Sleep Point, weekend-days	.18 (.203)	.10 (.518)	.06 (.685)

Kindergarten school started mainly between 8:15 a.m. and 8:30 a.m. (all times in hours: minutes; mean = 8:24 a.m., SD = 0:12) and was directly related to the children's sleep end on week-days ($p<0.05$ for all methods, see Table 9). Children woke up about one hour before kindergarten start. Fifty % of the children were awakened by a family member, 46% by his/herself, one child by an alarm clock, and data of one child were missing. Only three children napped on week-days (two on weekend-days).

No significant effects of children's sex and SES was found for sleep start, sleep end, assumed sleep, actual sleep time, nocturnal wake time, and mid sleep point consistently for all three methods. On the other hand, there was a significant relation between age and sleep start (ANOVA; $F = 12.6$, $df = 1$, $p = 0.001$) and assumed sleep (ANOVA; $F = 10.6$, $df = 1$, $p = 0.002$) and mid sleep point (ANOVA; $F = 7.3$, $df = 1$, $p = 0.010$); older children had a later sleep start, a reduced sleep duration and a later mid sleep point.

4.2.3. Agreement rates between Actigraphy and Diary

To assess the agreement between actigraphy and diary, limits of agreement according to Bland and Altman (1986, 1999) were obtained. We calculated mean (d) (AC minus DI) and the standard deviation (SD) of the differences over actigraphy monitored and logged days for each sleep measure (sleep start, sleep end, assumed sleep, actual sleep time, nocturnal wake time, and mid sleep point). Limits of agreement were obtained as d – 1.96*SD and d + 1.96*SD. On the basis of the assumption of normally distributed differences we would expect 95% of the differences to lie between the limits. Limits of agreement were calculated separately for all days, weekdays and weekend-days (Table 10). Bland-Altman-Plots (1986, 1999) of the difference (AC – DI) against the mean ((AC+DI)/2) were presented for our six

parameters (Figure 2). The differences for sleep start and sleep end were not normally distributed, but the deviations were not strong (Q-Q-Plots, not presented). A priori we defined a satisfactory agreement if differences were smaller than 30 minutes. This requirement was essentially satisfied for four of the six parameters, for which differences were ± 28 minutes, ± 24 minutes, ±32 minutes, ±21 minutes for sleep start, sleep end, assumed sleep, mid sleep point respectively. For actual sleep time and nocturnal wake time it was not satisfied for which differences were ± 106 minutes and ± 55 minutes (all days). For weekdays and weekend-days the differences were larger. Sex and age of the children, the age of parents, and SES did not significantly influence the differences between actigraphy and diary for all six parameters (p>.05).

Table 10. Mean (SD) and Limits of Agreement (Actigraphy minus Diary) in hours: minutes.

	Mean (SD)	**M – (1.96*SD)**	**M + (1.96*SD)**	**Range (in min)***	**P-Value†**
Sleep Start, all days	0:09 (0:14)	-0:19	0:37	± 28 min	<0.001
Sleep Start, *week-days*	0:01 (0:22)	-0:41	0:44	± 43 min	
Sleep Start, *weekend-days*:	0:25 (0:36)	-0:45	1:36	± 71 min	
Sleep End, all days	-0:10 (0:12)	-0:34	0:14	± 24 min	<0.001
Sleep End, *week-days*	-0:19 (0:17)	-0:52	0:14	± 33 min	
Sleep End, *weekend-days*	0:10 (0:35)	-0:59	1:17	± 68 min	
Assumed Sleep, all days	-0:14 (0:16)	-0:51	0:13	± 32 min	<0.001
Assumed Sleep, *week-days*	-0:21 (0:21)	-1:02	0:20	± 41 min	
Assumed Sleep, *weekend-days*	-0:14 (0:41)	-1:34	1:05	± 80 min	
Actual sleep time, all days	-1:46 (0:37)	-2:57	-0:34	± 72 min	<0.001
Actual sleep time, *weekdays*	-1:48 (0:42)	-3:10	-0:26	± 82 min	
Actual sleep time, *weekend-days*	-1:40 (0:46)	-3:11	-0:10	± 91 min	
Nocturnal wake time, all days	1:26 (0:28)	0:31	2:21	± 55 min	<0.001
Nocturnal wake time, *weekdays*	1:26 (0:30)	0:28	2:25	± 59 min	
Nocturnal wake time, *weekend-days*	1:25 (0:28)	0:30	2:20	± 55 min	
Mid Sleep Point, all days	-0:01 (0:11)	-0:21	0:20	± 21 min	0.709
Mid Sleep Point, *weekdays*	-0:09 (0:16)	-0:41	0:21	± 31 min	
Mid Sleep Point, *weekend-days*	0:18 (0:30)	-0:40	1:17	± 58 min	

† paired *t*-test between all days of actigraphy and diary data

* Range in minutes = SD*1.96*60

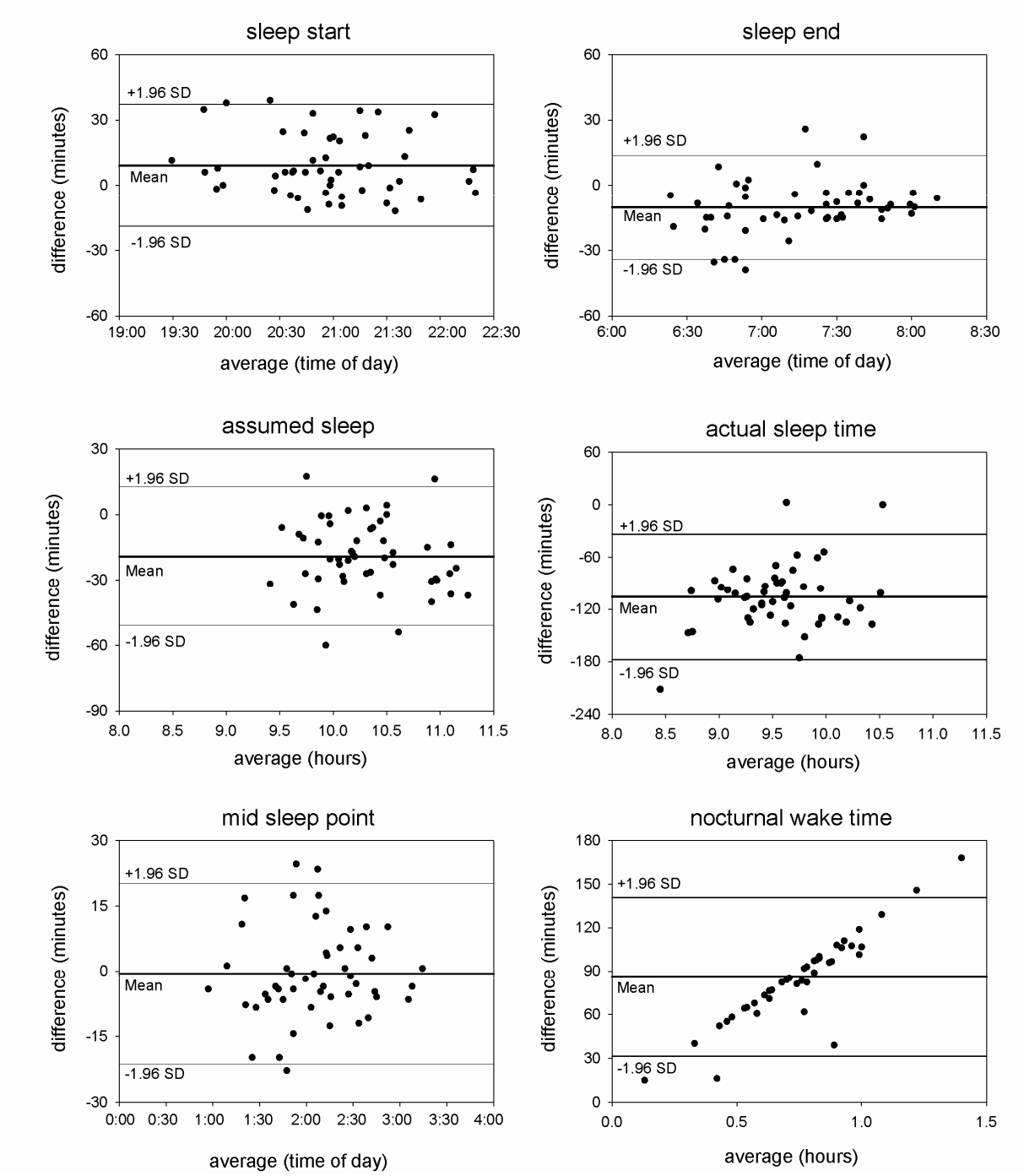

Figure 8. Bland-Altman-Plots of the difference between actigraphy and diary data for sleep start, sleep end, assumed sleep, actual sleep time, mid sleep point and nocturnal wake time.

4.2.4. Agreement rates between Actigraphy and Questionnaire

Limits of agreement were also calculated for actigraphy and questionnaire data (AC minus QU) as indicated above and reported in Table 11. A prior defined satisfactory agreement of 30 minutes was not reached for any parameters. Again, there were no significant sex, age, SES effects on the differences (p>.05).

Table 11. Mean (SD) and Limits of Agreement (Actigraphy minus Questionnaire) in hours: minutes.

	Mean (SD)	**M + (1.96*SD)**	**M – (1.96*SD)**	**Range (in min)**	**P-Value‡**
Sleep Start, *week-days*	0:13 (0:29)	1:09	-0:44	± 56.5min	0.004
Sleep Start, *weekend-days*	0:23 (0:35)	1:31	-0:46	± 68min	
Sleep End, *week-days*	-0:10 (0:31)	0:53	-1:12	± 62.5min	<0.001
Sleep End, *weekend-days*	-0:17 (0:37)	0:56	-1:30	± 73.5min	
Assumed Sleep, *week-days*	-0:22 (0:36)	0:49	-1:33	± 71min	0.038
Assumed Sleep, *weekend-days*	-0:39 (0:46)	0:52	-2:10	± 91min	
Mid Sleep Point, *week-day*	0:01 (0:24)	0:49	0:46	± 48min	<0.001
Mid Sleep Point, *weekend-day*	0:03 (0:28)	0:57	0:52	± 55min	

‡ paired *t*-test between weekdays of actigraphy and questionnaire data

4.2.5. Agreement rates between Diary and Questionnaire

Limits of agreement were also calculated for Diary and Questionnaire data (DI minus QU), and results presented for sleep start, sleep end, assumed sleep, and mid sleep point separately for week-days and weekend-days (Table 12). A prior defined satisfactory agreement of 30 minutes was for all three parameters not satisfied for weekdays as well as for weekend-days. Again, there were no significant sex, age, SES effects on the differences (p>.05).

Table 12. Mean (SD) and Limits of Agreement (Diary minus Questionnaire) in hours: minutes.

	Mean (SD)	**M + (1.96*SD)**	**M – (1.96*SD)**	**Range (in min)**	**P-Value§**
Sleep Start, *week-days*	0:11 (0:28)	1:07	-0:44	± 55.5min	0.008
Sleep Start, *weekend-days*	-0:04 (0:34)	1:03	-1:10	± 66.5min	
Sleep End, *week-days*	0:10 (0:26)	1:01	-0:42	± 51.5min	0.015
Sleep End, *weekend-days*	-0:27 (0:47)	1:05	-1:58	± 91.5min	
Assumed Sleep, *week-days*	-0:01 (0:34)	1:05	-1:07	± 66min	>0.05
Assumed Sleep, *weekend-days*	-0:25 (0:49)	1:12	-2:01	± 96.5min	
Mid Sleep Point, *week-day*	0:10 (0:22)	0:53	-0:32	± 43min	<0.001
Mid Sleep Point, *weekend-day*	-0:16 (0:33)	0:49	-1:21	± 65min	

§ paired *t*-test between weekdays of diary and questionnaire data

4.3. Part 3: Children's and mothers' sleep-wake patterns assessed by actigraphy.

This part is in preparation for publication.

4.3.1. Included Participants

Of the 63 kindergarten children, 42 children and their biological mothers were included in the data analysis [18 girls and 24 boys, mean age 5.9 ± 0.6 (SD) years, range = 4-7 years; mothers' mean age 38.4 ± 4.0 (SD) years, range = 31-47 years]. At time of assessment, 26 children (62%) slept in their own bedroom and 16 children (38%) shared their room with a sibling. Five of the 16 children (27%) shared their room with an older sibling and 11 children (73%) with a younger or a sibling of the same age. 38 of the mothers (91%) were married and lived together with the biological father of the child, 3 were a single parent (7%), and one mother was divorced and lived with a new partner (2%). 28 mothers (67 %) were at least in part-time employed and 14 were not employed (33%). 35 mothers (83%) indicated to be the primary caregiver of the child, whereas 7 mothers (17%) indicated that both parents (mother and father) were the primary caregivers of the child.

Overall, 21 families were excluded because of (*a*) missing biological mothers and deregistration (n=3); (*b*) missing actigraphy data of child or mother [n=14; child's refusal to wear the actigraph (n=3), technical problems with either actigraph (n=7), actimeter loss of mother or child (n=2), father was single parent and served as informant (n=1), and night-shift work schedules of the mother (n=1)]; (*c*) mothers had two kindergarten children, of which both children took part in the study, but only one child was included in the data analysis based upon radom selection (n=3); and (*d*) missing PSI-SF data (n=1).

4.3.2. Reliability estimates for monitored actigraphy days

The total number of actigraphy monitored days ranged from 6 to 8, with 60% of the mother-child dyads having 8 monitored days [7 days (21%); 6 days (19%)]. The number of weekdays (SC) ranged from 3 to 6 [3 days (2%), 4 days (19%), 5 days (34%), 6 days (45%)], and weekend-days (FR) ranged from 1 to 4, with 69% having 2 weekend-days [1 day (7%), 3 days (21%), 4 days (2%)]. Reliability estimates for children's and mothers' actigraphically estimated sleep/wake parameters aggregated over all days (ALL), over weekdays (SC) and weekend-days (FR) are presented in Table 13. Except for sleep latency, children's reliability estimates for sleep scheduled and quality variables for all days and scheduled days were found to be adequate (ICC > .70; Acebo et al., 1999), while some reliability estimates of

sleep-wake patterns for free days were found to be not adequate (ICC < .70; e.g., bed time, sleep duration). In contrast to children's reliability estimates, some reliability measures for all days and weekdays of the mothers were found to be not adequate and so for nearly all estimates on weekend-days (FR).

Table 13. Intra Class Correlation Coefficient (ICC) for children's and mothers' sleep scheduled and quality parameters over all days, weekdays (SC) and weekend-days (FR). (n=42).

	Children			Mothers		
	ALL	SC	FR	ALL	SC	FR
Sleep scheduled variables						
Bed time	**.86**	**.87**	.55	**.81**	**.76**	.40
Sleep start	**.84**	**.87**	.43	**.80**	**.76**	.40
Sleep end	**.85**	**.85**	**.77**	.60	**.82**	.19
Get up time	**.81**	**.84**	**.80**	.58	**.82**	.15
Assumed sleep (sleep period)	**.75**	**.74**	.14	.63	.66	.27
Mid sleep point	**.78**	**.90**	**.70**	**.78**	**.83**	.37
Sleep quality variables						
Sleep latency	.66	.59	.10	-.09	-.08	.05
Wake time (%)	**.87**	**.82**	**.75**	**.88**	**.82**	.66
Number of wake bouts / h	**.89**	**.85**	**.79**	**.89**	**.89**	.53
Motionless sleep percentage	**.90**	**.86**	**.74**	**.90**	**.87**	.64

Note: ICC > 0.70 is proposed to be of adequate reliability (Acebo et al., 1999).

4.3.3. Children's and mothers' sleep scheduled and quality parameters

As mentioned in the Method section, actigraphically estimated sleep-wake patterns were classified in scheduled and quality variables. Whereas sleep scheduled variables as well as the quality variable 'sleep latency' are absolute values, the other sleep quality variables are relative estimates referred to individual's sleep duration. Pearson and canonical correlations between the various scheduled and quality variables indicate that these two sets of variables are independent (but high correlations for the variables within the group are found), reflecting that those who have earlier sleep phases do not have better or worse sleep quality (same finding for children and mothers).

Descriptive statistics for children's and mothers' sleep scheduled and quality parameters are shown separately for all days, scheduled and free days in Table 14. Because significant age effects for parent-reported children's sleep scheduled variables have been reported in part 1 of the ZCSS (see above), we assessed whether similar effects were present for actigraphically estimated sleep scheduled variables (all days). Linear regression for all sleep scheduled variables showed that this was the case while no effects are reported for age. Except for get up time in the morning, no significant age effect was found for mothers' sleep

scheduled variables (older mothers get up later). Furthermore, no significant age effect was found for children's and mothers' sleep quality measures.

Differences between scheduled and free days as well as between children and mothers were analysized by 2-way Analysis of Variance (if the interaction was significant no effects for the 2 factors are presented). For sleep end, get up time, and sleep duration, there is a significant interaction between the 2 factors type of day (SC/FR) and generation (mother/child), meaning that differences between scheduled and free days are not equal for children and mothers; in other words, differences between children and mothers are not the same for scheduled and free days. For example for get up time, mothers get up before children on scheduled days, while on free days, they get up later than their children. On the other hand, for sleep duration, children slept on average the same duration on scheduled and free days, while mothers slept significantly longer on free days. For the 3 other scheduled variables, there was no significant interaction between the 2 factors, which allowed examining the effects for the type of day (SC/FR) and for generation (mother/child) separately. For example for bed time and mid sleep point, children went earlier to bed and had an earlier mid sleep point than mothers, but both, children and mothers, delayed bed time and mid sleep point from scheduled to free days (e.g., about 30 minutes for bedtime and about 36 minutes for mid sleep point). For none of the sleep quality parameters, there was a significant interaction. While mothers had shorter sleep latencies, had less wake time, fewer wake bouts and more motionless sleep than their children, for all sleep quality parameters there was no significant difference between scheduled and free days.

Children's sleep quality was not influenced by the fact of sleeping in an own or not own bedroom, by the employment of the mothers or SES; mothers' sleep quality was not influenced by her employment, the number of children in the family or SES.

Table 14. Children's and mothers' sleep scheduled and quality parameters over 6-8 days (ALL), weekdays (SC) and weekend-days (FR) assessed by actigraphy. (n=42).

	Children			Mothers			Statistics[×]		
	ALL	SC	FR*	ALL	SC	FR*	Differences SC-FR	Differences Mother-Child	Interaction
Scheduled variables									
Bed time	20:37 (0:37)	20:28 (0:35)	20:58 (0:49)	23:11 (0:43)	23:05 (0:41)	23:22 (0:56)	0:28 □	-2:32 □	NS
Sleep start	20:58 (0:37)	20:49 (0:37)	21:20 (0:48)	23:20 (0:43)	23:14 (0:41)	23:31 (0:56)	0:26 □	-2:19 □	NS
Sleep end	7:07 (0:31)	6:58 (0:27)	7:27 (0:49) □	6:53 (0:27)	6:35 (0:27)	7:34 (0:43) □	-	-	-0:08; p = .007
Get up time	7:20 (0:28)	7:10 (0:25)	7:45 (0:49) □	7:03 (0:26)	6:46 (0:28)	7:44 (0:41) □	-	-	-0:07; p = .023
Assumed sleep	10:08 (0:28)	10:10 (0:30)	10:08 (0:38)	7:32 (0:37)	7:21 (0:40)	8:02 (0:51) □	-	-	-0:10; p =.002
Mid Sleep point	2:02 (0:31)	1:53 (0:28)	2:23 (0:44)	3:07 (0:30)	2:55 (0:28)	3:32 (0:43)	0:35 □	-1:04 □	NS
Quality variables									
Sleep latency	0:22 (0:10)	0:22 (0:11)	0:22 (0:13)	0:10 (0:03)	0:10 (0:04)	0:10 (0:07)	-0:00:06	0:11 □	NS
Wake time (%)	14.78 (3.20)	14.96 (3.39)	14.43 (3.63)	11.35 (3.05)	11.27 (2.86)	11.72 (3.84)	-0.09	3.33 □	NS
Number of wake bouts / hour	3.76 (0.55)	3.77 (0.55)	3.76 (0.71)	3.48 (0.67)	3.46 (0.69)	3.51 (0.76)	0.002	0.28 □	NS
Motionless sleep percentage	83.44 (3.62)	83.41 (3.71)	83.40 (4.14)	87.54 (3.16)	87.54 (3.16)	87.46 (3.11)	-0.07	-4.08 □	NS

Reported as mean (standard deviation), in hours:minutes.

***** T-Test (paired) between weekdays and weekend-days.

[×] Two-way analysis of variance for repeated measures.

□ $p \leq .001$, ‡ $p < .05$

4.3.4. Association between children's and mothers' sleep scheduled and quality parameters

Associations between children's and mothers' sleep scheduled and quality variables are shown in Table 15. Significant associations between children's and mothers' sleep scheduled parameters were found for bedtime, sleep start, sleep end, get up time, and mid sleep point (ALL, SC, FR). No significant associations were found between children's and mothers' sleep duration and for sleep quality variables. Canonical correlations between the four sleep quality variables of the children (Set1) and of the mothers (Set2) were not significant.

Table 15. Pearson correlations between children's and mothers' actigraphically estimated sleep scheduled and quality variables, separately for all days (ALL), weekdays (SC), and weekend-days (FR; n=42).

	P-Value		
	ALL	SC	FR
Scheduled variables			
Bed time	r = .39 ‡	r = .33 ‡	r = .38 ‡
Sleep start	r = .38 ‡	r = .55 ‡	r = .49 ‡
Sleep end	r = .56 □	r = .54 □	r = .51 □
Get up time	r = .56 □	r = .33 □	r = .37 □
Assumed sleep	NS	NS	NS
Mid Sleep point	r = .58 □	r = .53 □	r = .56 □
Quality variables			
Sleep latency	NS	NS	NS
Wake time (%)	NS	NS	NS
Number of wake bouts / hour	NS	NS	NS
Motionless sleep percentage	NS	NS	NS

□ $p \leq .001$, ‡ $p < .05$

Note: NS = not significant.

Note: Because mid sleep point over all days corrects already for the accumulated sleep deficit during the week, no correction MSFsc is presented as in Roenneberg et al. (2003).

4.3.4.1. Associations between children's and mothers' mean differences for sleep scheduled variables and children's sleep quality

Except for sleep latency, children's actigraphically estimated sleep quality measures were significantly related to differences between children's and mothers' bed time and sleep start time (all days), with larger mean differences between children and mothers associated with more wake time, more wake bouts per hour and less motionless sleep (Table 16). Mean differences between children's and mothers' sleep duration were also related to the numbers of wake bouts per hour and motionless sleep, indicating that smaller differences between children and mothers were associated with less number of wake bouts per hour and more

sleep motionless sleep. Differences between children's and mothers' mid sleep point were also related to two of the four sleep quality measures, with more wake time and more number of wake phases per hour, going with bigger differences between children's and mothers' mid sleep point.

Table 16. Pearson correlations between children's sleep quality variables and differences between children's and mothers' sleep scheduled variables (n=42).

	Children's sleep quality variables			
Child-mother differences	LAT	W%	NWBh	MOT
Bedtime, all days	NS	r = .37#	r = .37#	r = -.32#
Sleep start, all days	NS	r = .39#	r = .39#	r = -.34#
Sleep end, all days	NS	NS	NS	NS
Get up time, all days	NS	NS	NS	NS
Assumed sleep, all days	NS	NS (<.10)	r = -.33#	r =.32#
Mid sleep point, all days	NS	r = .37#	r = .34#	NS (<.10)

$p \leq .05$

Note: LAT = sleep latency; W% = wake time in percentage, NWBh = number of wake bouts per hour; MOT = motionless sleep percentage.

4.3.5. Children's and mothers' intra-individual variability of sleep scheduled and quality parameters

Intra-individual night-to-night variability of sleep scheduled and quality variables are presented in Table 17. Because the intra-individual variability over all days may be influenced by average differences between scheduled and free days and there was insufficient data for free days, only variability data for scheduled days are presented. Mean differences between children's and mothers' intra-individual variability for bedtime, sleep start, and sleep duration were significant, with mothers having higher night-to-night variability than the children. For the sleep scheduled variables sleep end, get up time and mid sleep point mean differences were not significant indicating that children and mothers have about the same variability from day-to-day or night-to-night. The same holds true for the sleep quality variables sleep latency, wake time and motionless sleep; whereas significant mean differences between children and mothers were found for the number of wake bouts per hour (mothers have more intra-individual variability for wake bouts per hour than the children).

Table 17. Intra-Individual Coefficient of Variation (CV) over actigraphy monitored weekdays (SC) for children's and mothers' sleep scheduled and quality variables. (n=42).

			Statistics	
	Children	Mothers	Diff (P-Value)*	Corr (P-Value)□
Scheduled variables				
Bed time	1.94 (1.15)	2.96 (1.54)	.001	NS
Sleep start	2.05 (1.08)	2.98 (1.45)	.003	NS
Sleep end	4.99 (2.72)	5.90 (4.75)	NS	NS
Get up time	4.27 (2.69)	5.58 (4.85)	NS	NS
Assumed sleep	5.10 (2.49)	11.10 (5.66)	.000	NS
Mid Sleep point	17.59 (10.27)	14.61 (6.46)	NS	NS
Quality variables				
Sleep latency	71.81 (29.84)	79.91 (31.33)	NS	NS
Wake time (%)	20.69 (9.19)	21.61 (10.63)	NS	NS
Number of wake bouts / hour	12.08 (4.85)	14.79 (5.48)	.011	NS
Motionless sleep percentage	3.23 (2.03)	2.70 (1.69)	NS	NS

Coefficient to Variation (CV) is reported as percentage.

* T-test (paired) between children's and mothers' CV.

□ Pearson Correlations between children's and mothers' CV.

Note: NS = not significant.

4.3.6. Association between children's and mothers' intra-individual variability of sleep scheduled and quality parameters

Associations between children's and mothers' night-to-night variability for sleep scheduled and quality variables on weekdays (SC) are shown in Table 17. No significant associations were found indicating that children of mothers with a higher night-to-night variability do not have a higher night-to-night variability.

4.3.7. Children's and mothers common wake phases

To explore common wake phases between children and mothers, minute-by-minute agreement of sleep/wake scores (S/W) defined by the software Actiware5® were calculated. The common sleep phase of children and mothers over all days lasted on average 7 hours 25 minutes (SD = 32 minutes). While nearly half of the mother-child dyads had no common wake phases > 5 minutes (49%) over all monitored actigraphy days, others had 1 to 7 common wake phases > 5 minutes [one to 2 wake phases: 11 mother-child dyads (27%); 3 to 4 phases: 7 mother-child dyads (17%); 5 to 7 wake phases: 3 mother-child dyads (7%)]. For those dyads for which there were common wake phases, the average duration was 17.9 minutes (SD = 10.8 minutes). The duration of the longest common wake phases > 5 minutes ranged from 5 to 20 minutes.

4.4. Part 4: Are children's and mothers' sleep-wake patterns related to parental distress?

This part is in preparation for publication.

4.4.1. Included participants

Of the 63 kindergarten children, 55 children and their mothers were included in the data analysis [25 girls and 33 boys, mean age 5.9 ± 0.6 (SD) years, range 4-7 years; mothers mean age 38.9 ± 4.4 (SD) years, range 31-49 years]. At time of assessment, 48 of 55 mothers (87%) were married and lived with the biological father of the child, 5 of the 55 mothers (9%) were single parent, and 2 (4%) mothers were divorced living with a new partner. Most of the mothers were part-time employed (69%) and had two children (68%) [4 families (7%) had one child, 10 families (18%) three children and 4 (7%) four children]. At time of assessment, 29 children (53%) were the eldest sibling or an only-child, and 26 children (47%) had an older sibling. None of the children took regular naps. The actigraphic analysis included data from the sub-sample of 42 mother-child-dyads (see Part 3).

Overall, 8 children were excluded because of (*a*) missing mother data and deregistration [n=3; father was single parent and served as informant (n=1); night-shift work schedules of the mother (n=1); missing MCTQ data (n=1)]; (*b*) mothers had two kindergarten children of which both children took part in the study, but only one child was included in the data analysis based upon radom selection (n=3); and (*c*) missing PSI-SF data (n=1).

4.4.2. Mothers' parental distress

The sum score 'total stress' (TS) ranged from 39 to 114 (mean = 67.8; SD = 15.9), with 4 mothers (7%) having a total stress score above the 90th percentile (score > 91). Mean and standard deviation for the subscale 'parental distress' (PD) was 23.5 (8.0), for 'parent-child dysfunctional interaction' (P-CDI) 18.1 (4.3), and for 'difficult child' (DC) 26.2 (7.1). The frequency of life events in the past year and total impact by life events as well as mothers' age, mothers' employment, and number of children in the family were not related to parental distress (sum score and subscales: $p > .05$). Moreover, children's age and sibling position were not related to parental distress, whereas children's sex and temperament were significantly related. Mothers of boys had higher scores on the subscale 'difficult child' (DC: $r = -.29$, $p < .05$).

Spearman correlations between parental distress and temperament scale scores are shown in Table 18. Children's emotionality was related to all three subscales as well as to TS,

with higher emotionality related to higher parental distress. Furthermore, emotionality was the only temperament scale score which was significantly related to subscale PD and TS, while P-CDI was also significantly related to shyness and DC also to sociability and activity. However, higher sociability scale scores are associated with less distress, while higher activity scores with more distress (DC).

To examine determinants of parental distress, multiple regressions were computed. Statistics for the multiple regressions are presented in Table 19 indicating that children's sex and the 4 temperament scale scores accounted for 18% for PD, 31% for PCDI, 70% for DC and for 44% for TST (R^2 not adjusted).

Table 18. Spearman Correlation between parental distress scale scores (PSI-SF) and children's temperament scale scores (EAS, n=55).

	Parental distress (PSI-SF)			
	PD	P-CDI	DC	TST
Emotionality	r = .35□	r = .44*	r = .75*	r = .61*
Shyness	NS	r = .34□	NS	NS
Sociability	NS	NS	r = -.28□	NS
Activity	NS	NS	r = .27□	NS

Note: NS = not significant, PD = Parental Distress; P-CDI = Parent-Child Dysfunctional Interaction; DC = Difficult Child; TST = Total STress.

* $p \leq .001$, □ $p < .05$

Table 19. Multiple regression analyses for parental distress scores. Children's temperament and sex as independents (n=55).

	Equation 1: *PD*			Equation 2: *P-CDI*		
Variables	B	SE	β	B	SE	β
Emotionality	.57	.28	.27*	.50	.14	.44**
Shyness	-.18	.27	-.10	.24	.13	.25
Sociability	-.96	.49	-.29	-.16	.24	-.09
Activity	.31	.32	.14	-.003	.16	-.002
Sex	-1.47	2.24	-.09	.38	1.11	.04
	Equation 3: *DC*			Equation 4: *TST*		
Variables	B	SE	β	B	SE	β
Emotionality	1.35	.15	.73**	2.36	.46	.57**
Shyness	-.10	.14	-.06	.00	.44	.00
Sociability	-.77	.26	-.26*	-1.73	.80	-.26
Activity	.50	.17	.26*	.78	.52	.18
Sex	-1.06	1.21	-.08	-2.18	.52	-.07

Equation 1: $F = 2.05$; $p > .05$; $R^2 = .18$; $R^2adj. = .09$

Equation 2: $F = 4.38$; $p \leq .05$; $R^2 = .31$; $R^2adj. = .24$

Equation 3: $F = 21.83$; $p \leq .001$; $R^2 = .70$; $R^2adj. = .66$

Equation 4: $F = 7.67$; $p \leq .001$; $R^2 = .44$; $R^2adj. = .39$

* $p \leq .05$, ** $p \leq .001$

4.4.3. Mothers' self-reported sleep-wake patterns

Descriptive statistics for mothers' self-reported sleep-wake patterns are shown separately for scheduled and free days in Table 20. Because similar information about actigraphy was already presented in Part 3 of the thesis, significances will not be reported in detail. Overall, mothers significantly delayed their bed time, sleep onset time, and get up time from scheduled to free days, and slept significantly longer on free days compared to scheduled days. 13 of 54 mothers (24%; one missing) had a morning chronotype score, 28 of 54 (52%) an intermediate, and 13 (24%) an evening chronotype score (CT score). Mothers' sleep quality score (SQ) ranged from 1 to 10 (mean = 7.4, SD = 2.4, median = 8), with 26% reaching the highest score. Except for sleep inertia on free days, no age effects were found for mothers' sleep-wake patterns, CT score and sleep quality score ($p>.05$).

Table 20. Descriptive statistics for self-reported sleep/wake parameters on scheduled and free days (n=55).

	Mothers (MCTQ)		
	Scheduled Days[a]	Free Days[a]	Statistics*
Bed time	22:35 (0:43)	23:07 (0:46)	< .001, $d = 0.70$
Sleep latency	0:13 (0:13)	0:11 (0:12)	.062, $d = 0.10$
Sleep onset	22:48 (0:44)	23:18 (0:47)	< .001, $d = 0.65$
Get up time	6:44 (0:32)	8:01 (0:44)	< .001, $d = 2.05$
Time fully alert	7:14 (0:50)	8:24 (0:47)	< .001, $d = 1.43$
Sleep period	7:56 (0:41)	8:43 (0:44)	< .001, $d = 1.12$
Time in bed	8:08 (0:42)	8:55 (0:43)	< .001, $d = 1.08$
Sleep inertia	0:31 (0:37)	0:22 (0:25)	NS, $d = 0.27$
Mid sleep point	2:46 (0:33)	3:40 (0:40)	< .001, $d = 1.48$
MSFsc	3:23 (0:38)		-

[a] Reported as mean (standard deviation), in hours : minutes.

* Wilcoxon Signed-Rank Test between scheduled and free days.

Note: NS = not significant.

4.4.4. Associations between mothers' self-reported sleep-wake patterns and parental distress

Except for get up time and sleep inertia on scheduled days, mothers' sleep-wake patterns (SC + FR) were not related to parental distress ($p > .05$). On scheduled days, mothers with earlier get up times had higher scores for the subscale DC ($r = -.31$, $p < .05$), and those with longer sleep inertias had higher scores for sum scale TS ($r = .31$, $p < .05$). After controlling for children's sex and temperament, both correlations were not significant. Furthermore, the subscale DC was significantly related to mothers' differences between scheduled and free days for get up time ($r = .27$, $p < .05$), time fully alert ($r = .33$, $p < .05$),

sleep period (r = .33, p < .05), and time in bed (r = .33, p < .05). After controlling for children's sex and temperament scale scores (emotionality, sociability and activity), the effects did not remain significant, although there was a trend for sleep period and time in bed (p < .10, with larger differences between scheduled and free days associated with higher parental distress).

Mothers' self-reported sleep quality was significantly related to the subscales PD and P-CDI as well as the sum score TS, with poorer self-rated sleep quality related to higher parental distress (PD: r = -.49, p < .001; P-CDI: r = -.31, p < .05; TS: -.45, p < .001). These effects remain significant after controlling for children's sex and temperament. Thus, mothers' self-reported sleep quality was considered as a further determinant of parental distress and was included in the multiple regression analyses. Multiple regression analyses for parental distress are shown in Table 21. Mothers' sleep quality (SQ) accounted for an increase from 18% to 41% for PD, from 31% to 43% for P-CDI, from 70% to 71% for DC, and from 44% to 65% for TS (R^2 not adjusted).

Table 21. Multiple regression analyses for parental distress scores. Children's temperament, sex and mothers' self-rated sleep quality as independents (n=55).

	Equation 1: *PD*			Equation 2: *P-CDI*		
Variables	B	SEB	β	B	SEB	β
Emotionality	.51	.22	.24*	.47	.13	.42**
Shyness	-.12	.21	-.07	.26	.12	.27*
Sociability	-.90	.39	-.27*	-.14	.22	-.08
Activity	.18	.25	.08	-.05	.14	-.04
Sex	-2.33	1.80	-.15	.09	1.02	.01
Sleep quality (SQ; mothers)	-1.78	.33	-.57**	-.60	.19	-.35*
	Equation 3: *DC*			Equation 4: *TST*		
Variables	B	SEB	β	B	SEB	β
Emotionality	1.34	.15	.72**	2.25	.37	.54**
Shyness	-.08	.14	-.06	.10	.35	.23
Sociability	-.76	.26	-.26*	-1.64	.64	-.25*
Activity	.47	.17	.24*	.57	.42	.13
Sex	-1.24	1.19	-.09	-3.58	2.96	-.11
Sleep quality (SQ; mothers)	-.37	.22	-.13	-2.88	.55	-.46**

Equation 1: $F = 7.47$; $p \leq .001$; $R^2 = .49$; $R^2adj. = .42$

Equation 2: $F = 5.99$; $p \leq .001$; $R^2 = .43$; $R^2adj. = .36$

Equation 3: $F = 19.37$; $p \leq .001$; $R^2 = .71$; $R^2adj. = .68$

Equation 4: $F = 14.52$; $p \leq .001$; $R^2 = .65$; $R^2adj. = .61$

* $p \leq .05$, ** $p \leq .001$

4.4.4.1. Associations between actigraphically estimated mothers' sleep scheduled/quality variables and parental distress

On a sub-sample of 42 mother-child dyads (see Part 3), associations between actigraphically estimated sleep-wake patterns (scheduled/quality variables) and parental distress were assessed. The sum score 'total stress' in the sub-sample ranged from 45 to 98 (mean = 66.3; SD = 13.0) with only one mother having a high level of stress above the 90 percentile (score > 91). As in the previous sample, children's age, sibling position, mothers' employment, and number of children in the family were not related to parental distress, whereas children's sex was related to subscale DC ($r = -.37$, $p < .05$) as well as to children's temperament (e.g., emotionality/TS: $r = .56$, $p < .001$).

Mothers' actigraphically estimated sleep scheduled variables (e.g., sleep start) and quality measures (e.g., motionless sleep percentage) were not significantly related to parental distress ($p > .05$).

4.4.4.2. Mothers' concordance between actigraphically estimated and self-reported sleep quality

To examine the concordance between actigraphically (all days) estimated and self-reported sleep quality, spearman correlations were examined. On the sub-sample of 42 mother-child dyads, mothers' sleep quality scores ranged from 2 to 10 (mean=7.6, SD=2.4, median=8) with 24% reaching the highest score. No significant correlations were found indicating that subjective sleep quality is not related to actigraphically estimated sleep quality measures.

4.4.4.3. Associations between actigraphically estimated mothers' night-to-night variability and parental distress

On the sub-sample of 42 mother-child dyads, mothers' night-to-night variability for sleep scheduled and quality variables on scheduled days was not significantly related to parental distress (TS and all subscales; $p > .05$).

4.4.5. Children's parent-reported sleep-wake patterns

Descriptive statistics for children's parent-reported sleep-wake patterns are shown separately for scheduled and free days in Table 22 (columns 2 + 3). As similar information was already reported in Part 3 by actigraphy data, significances will not be reported in detail. One major difference between parent-reported and actigraphically estimated sleep-wake

patterns was, that parents indicated that children slept significantly longer on free days than on scheduled days whereas no significances were found by actigraphy. 18 of 55 children (33%) were morning types, 27 of 55 (49%) intermediate types, and 10 of 55 (18%) evening types (CT score). Children's sleep quality score (SQ) ranged from 5 to 10 (mean = 9.1, SD = 1.3, median = 10) with 56% reaching the highest score (10).

Table 22. Descriptive statistics for parent-reported children's *ist* and *soll* sleep/wake parameters on scheduled and free days (n=55).

	ist		*soll*		Statistics‡		
	Scheduled Days	Free Days	Scheduled Days	Free Days	Differences FR-SC	Differences *ist-soll*	Interaction
Bed time	20:06 (0:30)	20:33 (0:47)	19:55 (0:25)	20:35 (0:46)	-	-	-0:04, p = .02
Time of lights off	20:22 (0:34)	20:47 (0:48)	20:05 (0:28)	20:43 (0:45)	-	-	-0:03, p = .04
Sleep latency	0:14 (0:17)	0:13 (0:17)	0:12 (0:07)		-	-	-
Sleep onset	20:35 (0:41)	20:59 (0:53)	20:17 (0:31)	20:55 (0:47)	-	-	-0:00:21, p = .03
Get up time	7:19 (0:32)	7:55 (0:46)	7:16 (0:19)	8:12 (0:32)	-	-	-0:00:29, p = .002
Sleep period	10:33 (0:37)	10:48 (0:43)	10:46 (0:40)	10:50 (0:43)	0:10‡	-0:07‡	NS
Time in bed	11:13 (0:34)	11:22 (0:44)	11:22 (0:45)	11:37 (0:45)	0:13□	-0:13□	NS
Mid sleep point	1:52 (0:32)	2:23 (0:46)	1:40 (0:28)	2:19 (0:44)	0:36□	-0:10‡	NS

Reported as mean (standard deviation), in hours : minutes.

‡ two-way of Analysis of Variance for repeated measures.

□ $p \leq .001$, ‡ $\leq .05$.

Note: NS = not significant; SC = scheduled days; FR = free days.

4.4.6. Associations between children's parent-reported sleep-wake patterns and parental distress

Significant associations between parental distress and children's parent-reported sleep-wake patterns were found for bedtime ($r = .35$, $p < .05$), time of lights off ($r = .37$, $p < .05$), sleep onset time ($r = .34$, $p < .05$) and mid sleep point on scheduled days ($r = .33$, $p < .05$) for the subscale P-CDI. Later bed times, later times of lights off, later sleep onset times and later mid sleep points on scheduled days were significantly related with higher scores on the subscale P-CDI. In contrast, children's sleep period and chronotype (as measured by CT and MSF) were not significantly related to parental distress (all subscales and TST, $p > .05$). Furthermore, no significant associations were found for free days and for PD, DC and TST. After controlling for children's sex and temperament the correlations remain significant.

Mean differences between scheduled and free days for children's parent-reported sleep-wake patterns as well as children's sleep quality were not related to parental distress ($p>.05$).

4.4.6.1. Associations between actigraphically estimated children's sleep scheduled/quality variables and parental distress

On the sub-sample of 42 mother-child dyads, children's actigraphically estimated sleep scheduled variables (e.g., sleep start) and quality measures (e.g., motionless sleep percentage) as well as mean differences between children's and mothers' sleep-wake patterns were not significantly related to parental distress.

4.4.6.2. Children's concordance between actigraphically estimated and parent-reported sleep quality

Similarly to mothers' data, concordance between children's actigraphically estimated (all days) and parent-reported sleep quality was examined by Spearman correlations. On the sub-sample of 42 mother-child dyads, children's sleep quality scores ranged from 5 to 10 (mean=9.3, SD=1.1, median=10) with 57% of the children reaching the highest score. No significant associations were found, indicating that also children's parent-reported sleep quality is not related to actigraphically estimated sleep quality measures.

4.4.6.3. Associations between actigraphically estimated children's night-to-night variability and parental distress

On the sub-sample of 42 mother-child dyads, children's night-to-night variability for sleep scheduled and quality variables on scheduled days was not significantly related to parental distress (for TST and the other subscales; $p > .05$).

4.4.6.4. Associations between actigraphically estimated children's and mothers' common wake phases and parental distress

As reported in Part 3, wake phases > 5 minutes between children and mothers for the 6-8 actigraphy monitoring days were assessed. On the sub-sample of 42 mother-child dyads, the duration of the longest common wake phase > 5 minutes was not significantly related to parental distress, although there was a trend for the subscale DC ($r = .29$, $p = .07$) and sum score TST ($r = .28$, $p = .08$), with longer common wake phases associated with higher parental distress. The summed duration of all occurred wake phases during the 6-8 actigraphy monitoring days was not related to parental distress ($p > .05$).

4.4.7. Parental expectations for children's sleep-wake patterns

During the face-to-face interview, mothers were asked about children's *soll* sleep-wake patterns: what would be, in their opinion, the *soll* time for the child to go to bed (or get up). As sleep is primarily defined by endogenous components, larger differences between *soll* and *ist* sleep times would indicate less appropriate parental expectations.

Descriptive statistics for children's *soll* sleep-wake patterns are shown in Table 22 (columns 4 + 5). Differences between scheduled and free days as well as between *ist* and *soll* sleep-wake patterns were analyzed by 2-way Analysis of Variance for repeated measures (if the interaction was significant no effects for the 2 factors are presented). For bedtime, time of lights off, sleep onset, and get up time, there is a significant interaction between these 2 factors (SC/FR and *ist/soll*) indicating that differences between *ist* and *soll* sleep-wake patterns are not equal for scheduled and free days. Overall, differences between *ist* and *soll* are smaller than the differences between scheduled and free days. For sleep period, time in bed and mid sleep point, there were significant mean differences between *ist* and *soll*, equal for scheduled and free days. Differences between *ist* and *soll* sleep-wake patterns were not related to children's sex, sibling position, SES, and mothers' employment, while differences between *ist* and *soll* for time of lights off (SC+FR), sleep onset (SC+FR), and get up time on free days was significantly related to children's chronotype measured by CT scores.

4.4.8. Associations between parental expectations and parental distress

In contrast to the finding, that children's bedtime, time of lights off and sleep onset times on scheduled days were related to parental distress (P-CDI), children's *soll* sleep-wake patterns were not ($p > .05$). Spearman correlations between *ist/soll*-differences for children's sleep-wake patterns and parental distress were also significant for the subscale P-CDI. On scheduled days, larger differences between *soll* and *ist* for times of lights off ($r = .28$, $p < .05$) and for sleep onset times ($r = .27$, $p < .05$) were associated with more dysfunctional interactions between children and mothers. No significant associations were found for free days and PD, DC and TS ($p > .05$). These associations remain significant after controlling for children's sex, temperament (emotionality, shyness), age and SES. Thus, ist/soll-differences for time of lights off were considered as a further determinant of parental distress and was included in the multiple regression analyses.

4.4.9. Does 'misfit' account for parental distress?

As above, multiple regressions analyses were computed. Differences between *ist* and *soll* for time of lights off were added to the previous selected variables (temperament, sex, mothers' sleep quality). Statistics for the multiple regression analyses are presented in Table 23. *Ist/soll* differences accounted for P-CDI for 6% more than the other variables, for DC 5% and for TS 1% (R^2 not adjusted).

Table 23. Multiple regression analyses for parental distress scores. Children's temperament, sex, mothers' self-rated sleep quality and parental expectations as independents (n=55).

	Equation 1: *PD*			Equation 2: *P-CDI*		
Variables	B	SEB	β	B	SEB	β
Emotionality	.52	.23	.25*	.45	.12	.40**
Shyness	-.11	.22	-.07	.25	.12	.27*
Sociability	-.95	.40	-.29*	-.04	.22	-.02
Activity	.13	.27	.06	.06	.15	.05
Sex	-2.22	1.82	-.14	-.13	.99	-.02
Sleep quality (SQ; mothers)	-1.83	.34	-.58**	-.50	.19	-.30*
ist/soll differences for time of lights off	-1.65	2.70	-.08	3.12	1.47	.27*
	Equation 3: *DC*			Equation 4: *TST*		
Variables	B	SEB	β	B	SEB	β
Emotionality	1.30	.14	.70**	2.21	.37	.53**
Shyness	-.09	.13	-.06	.09	.35	.03
Sociability	-.60	.24	-.20*	-1.47	.65	-.22*
Activity	.63	.16	.33**	.74	.44	.17
Sex	-1.59	1.10	-.11	-3.94	2.96	-.12
Sleep quality (SQ; mothers)	-.23	.21	-.08	-2.72	.56	-.43**
ist/soll differences for time of lights off	5.02	1.63	.26*	5.28	4.40	.12

Equation 1: $F = 6.37$; $p \leq .001$; $R^2 = .49$; $R^2adj. = .42$

Equation 2: $F = 6.19$; $p \leq .001$; $R^2 = .49$; $R^2adj. = .41$

Equation 3: $F = 20.95$; $p \leq .001$; $R^2 = .76$; $R^2adj. = .73$

Equation 4: $F = 12.77$; $p \leq .001$; $R^2 = .66$; $R^2adj. = .61$

* $p \leq .05$, ** $p \leq .001$

5. Discussion

For each part (1-4) of the thesis, a short summary of the results is given followed by the discussion of the findings. An overall discussion with clinical implications and directions for future research is given in section 6.

5.1. Part 1: Validity and Reliability of the CCTQ.

This part of the study describes the assessment of chronotype in children between 4 and 11 years of age using three different measures: the Mid Sleep point on Free days (MSF), the Morningness/Eveningness scale (M/E) score, and a 5-point Chronotype (CT) score. To our knowledge, no parent-reported questionnaire with adequate reliability and validity is available for the assessment of children's chronotype in prepubertal children. We adapted measures of morningness/eveningness used in adolescents and adults (from Carskadon et al., 1993; Horne & Östberg, 1976; Smith et al., 1989) and combined them with other measures used in the literature (i.e., the MSF and the CT) into a single questionnaire (CCTQ). The study provides validity data for the CCTQ using actigraphy, as well as 2-4 week test-retest reliability data. Overall, findings indicate moderate to strong agreement between the three chronotype measures, adequate associations between sleep/wake parameters (parent-report and actigraphy) and chronotype measures, and excellent temporal stability for all three chronotype measures (reliability).

Comparisons between the three chronotype measures and parental reports of sleep/wake parameters suggest stronger relations between sleep/wake parameters and MSF/MSFsc than between sleep/wake parameters and M/E or CT. Higher correlations with MSF/MSFsc may be explained by the fact that these measures are computed derivations of reported sleep onset and sleep period, while assessment of M/E and the CT require methodologically distinct responses from parents. The M/E score is a sum score of multiple items measuring children's "best" time to sleep, take a cognitive test, and do physical activities, as well as children's level of sleepiness at different times of the day. Likewise, the CT is an overall parental impression of children's chronotype using five response choices. Our results indicate that later chronotypes as measured by MSF/MSFsc, M/E, and CT are more likely to have later bed times, lights-off times, and sleep onset times, longer sleep latencies, later wake up and get up times, and take longer to be fully alert in the morning than earlier chronotypes (independent of type of day). These findings are consistent with previous reports on circadian preference with adolescents and adults (e.g. Carskadon et al., 1993;

Roenneberg et al., 2003), suggesting that the CCTQ adequately measures chronotype in prepubertal children.

The validity of parent-reported sleep/wake parameters and chronotype measures was examined by objective data (actigraphy). The relationship between bed time, sleep onset, wake up time, and children's chronotype was verified with estimates from actigraphy. The finding that sleep latency was significantly related to children's chronotype was not verified with estimates from actigraphy. This may due to parents' difficulty in providing accurate estimates of sleep latency, especially for later chronotypes (i.e., children's sleep onset is later than their parents') or for children who require little-to-no assistance in falling asleep at bedtime. While many sleep/wake parameters significantly differ between actigraphy and questionnaire data, mid sleep point on scheduled and free days did not. This finding indicates objective validity for the chronotype measure MSF. The significant discrepancies between actigraphy and questionnaire data in sleep/wake parameters are well documented in the literature (Acebo, 2005; Sadeh, 1991; Sadeh, 1994; Werner, 2008) and may be explained by methodological differences (e.g., actigraphy estimates sleep/wake patterns based on movements during specified time intervals while subjective reports may be influenced by recall, experiences, and expectations and are not primarily based on a particular time window).

Relations between the three different chronotype measures (MSF/MSFsc, M/E, and CT) were moderate-to-high. The strongest correlation was between M/E and CT, which may be explained by the sequence of filling out the CT after the two other measures. That is, parents may have become more in tune with the chronotype construct after completing questions resulting in MSF and M/E. High correlations between M/E scores and CT have been also reported in adult populations by Roenneberg [r= -.80; chronotype self-assessment on a 7-point scale (Roenneberg et al., 2007)].

Although the correlations between the three different chronotype measures in our study were moderate-to-high, some incorrect classifications of morning types as evening types and vice versa may have occurred. Comparing for example the M/E- and CT-scores classified into three groups (morning-types, intermediate-types, and evening-types), our data may suggest that extreme misclassifications were rare. Because an honest false classification rate can not be provided by our analyses, further studies should compare parent-reported chronotype measures with physiological circadian parameters (e.g., dim light melatonin onset), which may provide additional validity data for classifying children's chronotype.

The test-retest analysis of sleep/wake parameters and the three chronotype measures suggests excellent temporal stability. A test-retest period of 2-4 weeks was chosen according to (Knapp, 1995) who showed that a time period of 2-4 weeks is not too short (the shorter the interval, the more answers of the first administration may be recalled and thereby producing an artificially high estimate of the instrument), and not too long (the longer the interval, the more likely the true scores may have changed). The reliability coefficient for sleep latency and sleep inertia was influenced by two individual subjects for whom the difference between the 2 administrations was about half an hour (range of remaining values: -0.25 to 0.33). When these subjects were discarded from the analysis, the correlation was higher. We cannot distinguish whether the moderate test retest correlation of sleep latency and sleep inertia is due to more variability of the child's behaviour (e.g., difficulty falling asleep due to stressful events) or to less reliability of the parent report (e.g., if children do not need parents assistance to fall asleep).

Data from many reports in adolescents and adults show that individuals delay their sleep on average by 1-3 hours from scheduled to free days and sleep longer during free days, which has been interpreted as an accumulated sleep deficit (e.g., Carskadon et al., 1993; Roenneberg et al., 2004). These findings prompted Roenneberg and colleagues to correct MSF for the accumulated sleep deficit during the work week (see Appendix in Roenneberg et al., 2004). Our data indicate that the delaying pattern is already evident in prepubertal children, although to a lesser degree than in older children and adults. We found that prepubertal children delay on average their sleep onset for 26 minutes and wake up time for 44 minutes and therefore sleep 18 minutes longer on free days than on scheduled days. Compared to (Wolfson & Carskadon, 1998), 15-year-old adolescents go to bed 106 minutes later and get up 220 minutes later on weekends, oversleeping 114 minutes. The age effect on sleep/wake patterns (e.g. Wolfson & Carskadon, 1998; Iglowstein et al., 2003; Randler, 2008) is likely influenced by environmental factors (e.g., increasing night time activity and setting their own bedtimes) and biological factors (e.g., maturation of the circadian system and the sleep/wake homeostatic regulatory processes (Carskadon et al., 1993; Jenni et al., 2005a; Jenni & LeBourgeois, 2006). As a consequence, we corrected MSF for the accumulated sleep deficit as suggested by Roenneberg (2004).

We note that the study participation was voluntary, and the study population represents a small community sample, with an imbalance between the number of children aged 4-7 and those aged 7-11 years. Furthermore, we did not collect concurrent self-reported data from school children, and parents were not asked to report sleep/wake parameters to

specified precision (e.g., 5 or 10 minutes), which may have resulted in significant deviation from normality for many sleep/wake parameters. Although this study presents findings in need of replication (also in different cultural groups; Caci et al., 2005), we still believe that the CCTQ is a convenient, brief, and easy-to-administer questionnaire providing three different chronotype measures. Which of these measures may be recommended for clinical or research use depends on particular questions and aims.

The results of Part 1 indicate that 4- to 11-year-old children already delay their sleep/wake patterns and "oversleep" about 15 minutes between scheduled and free days. As a consequence, prepubertal children, especially those with later chronotype classifications, may have difficulties obtaining sufficient sleep. Because eveningness is associated with increased daytime sleepiness, greater emotional, attentional, and behavioural problems, and poorer school achievement, knowing the individual's circadian phase preference may help the clinician dealing with these difficulties. We propose that the CCTQ be used in future studies, including those with clinical populations (e.g., sleep disorders, learning disorder, behavioural problems). We conclude that the all three measures included in the CCTQ (MSF, M/E and CT) are equally valid and reliable measures for the assessment of chronotype in prepubertal children between 4 and 11 years of age.

5.2. Part 2: Limits of Agreement.

The analysis of sleep-wake patterns in Part 2 presents agreement rates of the most common used methods in basic sleep research and clinical pediatric sleep medicine (questionnaire, diary, actigraphy) by the statistical approach proposed by Bland and Altman (1986, 1999) and describes various parameters within the different methods in healthy kindergarten children. Correlations generally indicate whether two methods are measuring the same underlying quantity (Bland & Altman, 1999). In fact, the validity of comparing measurements (ie, reflected by high correlations) is an essential requirement to compare different methods. A more suitable approach is to calculate mean differences between measurements on the same subject estimated by Student *t*-Tests. However, *t*-Tests do not provide an interval in which 95% of the differences between measurements are expected to lie (limits of agreement; Bland & Altman, 1999). The study provides normative data for agreement rates in a non-clinical sample of middle-upper class children.

The results are consistent with our hypothesis indicating that the agreement between actigraphy and diary regarding sleep start, sleep end, and assumed sleep is satisfactory. We defined an acceptable agreement between the methods on the basis of our clinical experience

if differences between measures were smaller than 30 minutes (notably, the diary intervals were 15 minutes). Both methods are approximations of the true value of a child's sleep patterns and we believe that a mean disagreement of 30 minutes between methods is insignificant for diagnosing and evaluating children's sleep difficulties. Thus, we conclude that actigraphy and diary can be interchangeably used for sleep start, sleep end, assumed sleep, and mid sleep point but not for variables related to nocturnal wake times (all days).

The agreement for actual sleep time and nocturnal wake time between actigraphy and diary data was not sufficient. Overall, actigraphy estimated always longer nocturnal wake phases than parents indicated in the diary and there were many parents who did not indicate any wake phases in the diary (see Bland-Altman-Plot; points in one line). This result is entirely in line with previous other studies (also in different age groups (Sadeh, 1996; Sadeh, 1994) and may be explained by the parents not being always aware of the sleep behavior of their child, for example when the child is not signalling during the night. In fact, child's signalling may affect parent's well-being (Pearl, 2002), which leads to higher alertness of child's nocturnal waking. Therefore, the lack of agreement in night waking in our study may be also due to the non clinical population with 4 to 7 years old children being awake during the night and not affecting parent's well-being. The diary recording of sleep-wake pattern in 15 minute intervals could also have affected the findings. However, collecting diary data in 15 minute intervals was seen to be most practical for the families in terms of adherence. Another explanation for the disagreement of actual sleep time and nocturnal wake time is that actigraphy and diary measure different things (i.e., nocturnal motor activity and subjective recollections of sleep; Lockley, 1999).

The agreement rates between actigraphy and questionnaire as well as between diary and questionnaire were not sufficient for any measure variable. This may be due to the questionnaire not asking about the last few days in which diary and actigraphy data had been collected. The agreement rates between questionnaire and actigraphy or diary may be lower the larger the asked time period of the questionnaire is, because the answers may be influenced by memories, experiences and expectations (recall bias). We also know that answers of parents are often vague and inaccurate with statements such as "it depends on the situation" and with reporting to the nearest half hour or even full hour. Thus, we believe that agreement rates between actigraphy and questionnaire may be improved by asking about the recent past time period (e.g., the last week) or especially about the time period of monitoring actigraphy data. In our population the agreement rates between the methods were not influenced by SES, sex or age of the children or the parent.

Overall, the sleep-wake diary is a valid and inexpensive source of information about child's sleep schedule variables. The diary is an important baseline tool for the health care professional when evaluating and attending children with behavioral sleep problems and is also a valuable instrument for the pediatric sleep researcher. Additional information about nocturnal wake times may be collected by actigraphy which can also be used if parents are unable to report in detail.

We are not aware of any other study in the sleep field using the statistical approach proposed by Bland and Altman (1986, 1999) for comparing different assessment techniques of sleep variables. In contrast to previous reported correlations and comparisons of mean differences, the estimation of limits of agreement proposed by Bland and Altman allows a statement regarding the interchangeably use (with a 5% probability of error) of different methods. We encourage others to apply this statistical method in other age groups and clinical populations to further answer the question which methods may be interchangeably used. Such information will be very helpful for the clinician.

5.3. Part 3: Children's and mothers' sleep-wake patterns assessed by actigraphy.

This part of the study describes sleep scheduled and quality variables as well as intra-individual variability of sleep measures of healthy kindergarten children and their biological mothers assessed by actigraphy. To our knowledge, only one study has addressed this topic in a non clinical sample, but in older children (Gau, 2004). The findings of our investigation show significant mean differences between children's and mothers' scheduled and quality variables, with specific differences between weekdays and weekend-days for children and mothers (e.g., sleep duration). Furthermore, there were significant associations between children's and mothers' sleep scheduled variables (e.g., bedtime, get up time, mid sleep point). No significant associations, however, were found for sleep quality measures (e.g., motionless sleep percentage) and night-to-night variability of both scheduled and quality variables.

For a reliable assessment of individual sleep-wake patterns by estimates from actigraphy, adequate reliability measures are necessary (Acebo et al., 1999). In this study, adequate estimates were found for many sleep scheduled and quality variables with the exception for sleep latency (for children and mothers). In PSG, sleep latency is defined as the period between the time of lights off and the first appearance of stage 2 NREM sleep, which can be precisely determined by the occurrence of sleep spindles or K-complexes. Because actigraphy monitors body movements and also reports false positives events (actigraphy

scores sleep when the subject is awake, especially during the time prior sleep onset when lying in bed without moving), we conclude that sleep latency defined by actigraphy is imprecise and, thus, findings should be interpreted with great caution. Overall, children's sleep scheduled and quality variables for all days and weekdays were found to be adequate (ICC > .70; Acebo et al., 1999), while some parameters for weekend-days were not sufficient. Mothers' reliability estimates for weekend-days were also found to be not adequate as well as some parameters (sleep end, get up time, sleep duration) for all days and weekdays. The low reliability estimates for weekend-days compared to weekdays and all days may be explained by the small number of weekend-days collected in this study (range 1-4). In line with Acebo et al. (1999) who showed that an increasing aggregation is associated with higher reliability, we conclude that mean values aggregated over 1 to 4 days are not sufficient for adequate reliability. Because there is a wealth of evidence that sleep may be influenced by many factors as for example the amount of prior sleep (Aserinsky & Kleitman, 1953), we may assume that less adequate reliability estimates on weekend-days may be also resulting from higher variability on weekend-days (e.g., situational influences that may affect sleep-wake patterns) rather than from error due to recording methodology.

Significant mean differences between children and mothers were found for all sleep scheduled and quality variables (except for sleep end), but with specific differences between weekdays and weekend-days for children and mothers for sleep end, get up time, and sleep duration. While mothers show earlier sleep end and get up times on weekdays than their children, they have later sleep end and get up times on weekend-days. This finding may reflect the fact that mothers need to get up earlier on weekdays for assisting their children in preparing for school start. In addition, because 67% of the mothers are part-time employed, it may also reflect that mothers have earlier work start times than their children's school starts. Moreover, while children had about the same sleep period on weekdays as weekend-days, mothers slept about 40 minutes longer on weekend-days. Thus, mothers seem to be recovering from an accumulated sleep deficit during the week by sleeping in on weekend-days (Roenneberg et al., 2003). If we compare the kindergarten children (age 4 to7 years; Part 2, 3, and 4) with the population of Part 1 (4 to 11 years old), we may suggest that only children from 7 years on begin to sleep significantly longer on weekend-days than weekdays. This may indicate that older children have earlier school start times (kindergarten: 8:15 to 8:30; school children: 7:45 to 8:15) which act as social zeitgebers for children's sleep end. Younger children may have also more possibilities to compensate for insufficient sleep during weekdays, because in older children evening activities generally increase. Nevertheless, the

finding that preschool aged children already show a small delay of their sleep phase with later sleep start and sleep end during weekends (Carskadon, 2004) highlights the need for collecting data for weekdays and weekend-days separately already in preschool children.

In contrast to age which is a strong predictor for many sleep-wake variables in children, no significant age effect was found for mothers' sleep scheduled variables (except for get up time). This finding may reflect the fact that sleep regulatory mechanisms develop during the course of puberty (Carskadon et al., 1993), while thereafter sleep processes remain unchanged (for age range: 31-47 years). Furthermore, no age effect was found for children's and mothers' sleep quality measures (by parent-report and actigraphically estimated) indicating that sleep quality does not underlie specific sleep regulatory mechanisms as described in Jenni and LeBourgeois (2006). Furthermore, no significant differences between weekdays and weekend-days were found for children's and mothers' sleep quality measures, while mothers compared to their children had shorter sleep latencies, less wake time, fewer wake bouts, and more motionless sleep. All sleep quality variables with the exception of sleep latency were corrected for individual's sleep duration (relative values; adults have shorter sleep duration than children), mothers may not have better sleep quality due to having shorter sleep durations anyway. Sleep quality estimated by actigraphy is computed based on activity counts. Thus, mothers' higher sleep quality may be due to being less active than their children because physical total activity declines with increasing age (Eaton & Reid Enns, 1986; Riddoch et al., 2003).

Differences between children's and mothers' sleep scheduled variables (all days) were significantly related to children's sleep quality variables; in other words, larger differences between children's and mothers' bed time and sleep start time were associated with poorer sleep quality of the children (more wake time, more wake bouts per hour and less motionless sleep). Furthermore, smaller mean differences between children's and mothers' sleep duration were related to higher sleep quality (less number of wake bouts per hour, more motionless sleep). Larger mean differences for children's and mothers' mid sleep point were associated to poorer sleep quality of the children. Although not all correlations for each sleep quality measure were significant at the 5% level, these findings may indicate that children's sleep quality is embedded within the family context and that differences in scheduled variables between mothers and children may modulate children's sleep quality. It may be that parents of children with similar sleep-wake patterns (e.g., sleep start times) interact and respond differently to their children. We may speculate for example that children of parents with similar sleep-wake patterns may not have the feeling to miss something or be excluded from

family life due to going earlier to bed than the others which may lead to better sleep quality of the children.

Significant differences between children and mothers were also found for intra-individual variability for bedtime, sleep start, and sleep duration, with mothers having higher night-to-night variability than their children. For sleep end time, get up time and mid sleep point mean differences were not significant. As shown above, mothers get up earlier on weekdays than their children. Thus, we suppose that social zeitgebers (e.g., children's school start or mothers' work start) do not allow some variability in getting up in the morning (for children as well as for mothers), while in the evening no other social zeitgeber is acting similarly strong resulting in more variability. However, children have less night-to-night variability than their mothers which may reflect the fact that children's sleep onset times in the evening is primarily defined by the parents (and not by themselves) and is less influenced by night-time activities compared to adults.

Significant associations between children's and mothers' sleep scheduled parameters were found for bedtime, sleep start, sleep end, get up time, and mid sleep point (ALL, SC, FR) indicating that children of mothers with later bed times and later sleep starts have also later bed times and sleep starts. Thus, the same is true for sleep end and get up time in the morning. Taken that MSF is a marker for individual's chronotype (Roenneberg et al., 2003; Werner et al. 2009), the data indicate that children of mothers with a later chronotype have also a later chronotype. The moderate correlation between children's and mothers' chronotype ($r = .58$) was confirmed by the significant correlations of the parent/self-reported CT score ($r = .56$; not presented in result section). Because children and mothers share environmental factors as well as genes, we cannot distinguish whether the moderate correlation is due to a common genetic component or due to common life experiences. Recent research has highlighted the importance of gene-environment interaction. Thus, it may also be that genes and life experience interact (Caspi et al., 2002). Moreover, Vink and colleagues (2001) who analyzed the influence of genetic factors on individual differences in chronotypes as measured by morningness-eveningness in a sample of Dutch adolescent twin families showed that relatives of different generations are less similar than relatives of the same generation. They suggested different explanations for their finding: the genetic dominance may contribute to phenotypes of parents and offsprings although this genetic factor may not be shared by them; genes may be switched off with increasing age or different genes are operating at different ages. In their study, they estimated a genetic correlation between generations of 0.30 and suggested that different genes for chronotypes as measured by M/E are expressed in both generations.

Although mothers and children share genes and environment, in our study no significant associations were found between children's and mothers' sleep duration and sleep quality measures.

Our findings may have significant practical implications. Health care practitioners should account for mothers' sleep scheduled variables as well as for their chronotype when a child is presented with problems associated with late or early sleep schedules as well as with an evening-type sleep profile. This recommendation is in contrast to that of Gau et al. (2004) which addressed this topic in a non clinical sample, but in older children. This may be due to the fact that sleep of younger children is much more embedded in family context and social practices than for older children and adolescents.

5.4. Part 4: Are children's and mothers' sleep-wake patterns related to parental distress?

This thesis assesses mothers' distress measured by PSI-SF (Abidin, 1995) and explores whether children's and/or mothers' sleep-wake patterns as well as the differences between them are related to parental distress. Our results indicate that mothers' self-rated sleep quality and some children's sleep-wake patterns (e.g., bedtime on scheduled days) are related to parental distress while no significant associations were found for mean differences between children and mothers. Furthermore, parental expectations for children's sleep-wake patterns, defined as *soll* sleep-wake patterns (what would be in parents' opinion, the *soll* time for the child to go to bed) and its associations with parental distress were assessed. The findings demonstrate that parental expectations for children's sleep-wake patterns were related to children's chronotype and significantly accounted for parental distress.

The mothers' parental distress as measured by PSI-SF was not significantly related to the frequency of life events in the past year, to the total impact by life events in the past year, to mothers' age and employment as well as to the number of children in the family and SES. Furthermore, children's age and sibling position were not related to parental distress. In contrast to this, children's sex and temperament was associated to distress; in other words, mothers of boys and mothers of children with higher emotionality (children with higher tendency to become aroused easily and intensely) had higher parental distress scores. Overall, multiple regressions show that children's sex and temperament account for 44% of the variance of the sum score 'total stress' and for 70% of the variance for subscale DC (R^2 not adjusted). As the subscale DC measures a parents' perception of the child's temperament, demandingness and non-compliance it is not surprising that the selected variables account for

70 % of the variance of the subscale DC. Higher sociability scores, however, are associated with less distress, whereas higher emotionality and activity scores with more distress.

Mothers' self-reported sleep scheduled variables (e.g., sleep duration, mid sleep point) were not related to parental distress while self-reported sleep quality scores (SQ) were related to higher scores on the subscales PD and P-CDI as well as with higher scores for TS (effects remained significant after controlling for children's sex and temperament). Because significant correlations may not be used to infer a causal relationship, we cannot determine whether mothers have higher parental distress scores due to poor sleep or whether they are not sleeping well due to higher distress. Interactions between stress and sleep has been explored in many studies (e.g., Buckley & Schatzberg, 2005; El-Sheikh et al., 2008) indicating that bidirectional effects are likely because sleep disruptions can affect stress-related hormonal levels and consequently changes in stress hormones can influence sleep patterns.

Mothers' self-rated sleep quality accounts for an improvement of 21% for TS scores (R^2 not adjusted), with the strongest increase in the subscale PD (31% rise of the variance). Because the subscale PD may be interpreted as an indicator of stress level resulting from personal factors (e.g., depression), it might be that the self-rated sleep quality score has been (implicit) interpreted as a kind of overall barometer of the mothers' physical and mental health.

Mothers' sleep scheduled variables were not related to parental distress which was verified by estimates from actigraphy. In contrast to the self-reported sleep quality, for which there were significant relations to parental distress, actigraphically estimated sleep quality variables were not. Therefore, we calculated concordance between self-reported and actigraphically estimated sleep quality measures, which indicated no significant associations, meaning that sleep quality assessed by self-report and by actigraphy are not measuring the same underlying quantity (e.g. motor acitivity versus overall well-being). Up to now, we are not aware of any study reporting subjective validity data for actigraphy. Actigraphy estimates sleep/wake parameters based on activity counts. Therefore, not every actigraphically estimated wake time indicates subjective perceived wake times (false negatives events). The ability of actigraphy to discriminate between sleep and wake as defined by PSG criteria has been evaluated by a number of studies which all indicate that actigraphy and PSG show high overall minute-by-minute agreement concordances [91-93% in adult populations (Ancoli-Israel et al., 2003); > 85% in healthy subjects of different age groups (Acebo & LeBourgeois, 2006)]. Since sleep episodes usually comprise more than 90% of sleep, total agreement rates are high despite the large discrepancies in wake detection (Paquet et al., 2007).

In contrast to mothers' sleep-wake patterns, which have not been related to parental distress, children's parent-reported bed time, time of lights off, sleep onset times and mid sleep point on scheduled days were significantly related to the subscale P-CDI, indicating that later sleep times are associated with higher distress scores (no significant correlations were found for free days). This may reflect the fact that mothers experience a higher pressure to bring their children to bed on time (so that they can get enough sleep) on scheduled days than on free days resulting in more difficult interactions between children and mothers and higher parental distress scores.

In contrast to our initial hypothesis, mean differences between mothers' and children's sleep-wake patterns (e.g., sleep duration, chronotype) were not significantly related to parental distress. This finding may lead us to the assumption that other variables account more and have stronger impact for parental distress. Furthermore, we assume that the significant associations between children's and mothers' sleep scheduled variables (e.g., mid sleep point) may explain the missing significant relation to parental distress, in the sense that there were more congruent and discrepant mother-child dyads. For example, classifying children's and mothers' mid sleep point in evening-, intermediate- and morning- types indicate that strongly discrepant pairs (morning-typed children and evening-typed mother) occurred only twice.

There were very few common wake phases between children and mothers (nearly half of the mother-child dyads had no common wake phases > 5 minutes (49%) over all monitored actigraphy days). Because study participants were non sleep disordered children, it seems not surprising that these very few common wake phases were not related to parental distress. Furthermore, 4 to 7 years old children may be able to self-soothe after waking up during the night without alerting their parents.

While there has been increasing attention to the link between children's sleep and parental cognitions in the past 5 years (Morrell & Steele, 2003; Sadeh et al., 2007), interactions between children and their parents in terms of expectancy effects are still largely neglected. Parental expectations for children's sleep-wake patterns have been defined by *soll* sleep-wake measures (larger differences between *ist* and *soll* would indicate less appropriate expectations). Our results indicate that mothers of children with later chronotypes as measured by CT scores, had less appropriate expectations for children's time of lights off and sleep onset time (on scheduled and free days) as well as for get up time on free days. Furthermore, larger differences between children's *ist* and *soll* sleep-wake patterns were associated with higher scores on the subscale P-CDI, indicating that difficult interactions between children and their mothers are related to inappropriate parental expectations,

although parental expectations for example for children's time of lights off only account for an improve of 6% for the subscale P-CDI.

6. Limitations and implications for future research

There are some study limitations which have to be considered when interpreting the results of this thesis. First, the study population of Part 2, 3 and 4 represents a community sample of healthy kindergarten children and their mothers from middle-to-upper socioeconomic status. Moreover, there was a low participation rate which may be explained by the time consuming procedure. In addition, although we propose that the CCTQ is a reliable and valid measure to assess children's chronotype, our results need further replications. For example, no honest false classification rate could have been provided for classifying children's chronotype. Future studies should compare parent-reported chronotype measures with physiological measures of the circadian system (e.g., melatonin). Furthermore, most interesting would be assessing children's chronotype even at a younger age. Until now, there is a lack of empirical data for younger children (< 4 years) and we do not know from which age on it may be possible to assess children's chronotype.

The agreement rates inform about the interchangeably use of the most commonly used methodological techniques in sleep research (actigraphy, diary, questionnaire). Beside the fact that actigraphy and diary can be interchangeably used for some sleep/wake parameters, each methodological approach is only an approximation of the true value of children's sleep and which of the different methodological techniques may be seen as a 'gold standard' has to be answered in the light of the specific questions and aim (subjective reports may also provide useful information). However, actigraphy has gained wide spread popularity in sleep research, but there are still several limitations about the methodology. Actigraphy estimates sleep/wake patterns derived from activity counts and might be less accurate for detecting wake than for sleep (Paquet et al., 2007). Unfortunately, we did not acquire data of sleep disordered children to compare agreement rates between healthy children and those with sleep problems. Thus, we suppose that agreement rates in clinical populations would be even higher due to having higher compliance.

Sleep is very sensitive to endogenous and environmental factors and the source for sleep disturbances is wide. Because children's sleep-wake regulation is embedded in the context of the family, it is important to study children's sleep in relation to characteristics of their primary caregivers (e.g., parental sleep-wake patterns). In this study, we were not able to show that differences between children and mothers sleep-wake patterns (e.g., chronotype) are related to parental distress. Beside the fact that there are many other variables accounting for parental distress, we found significant associations between children's and mothers' sleep

scheduled variables (e.g., mid sleep point). We assume that these significant associations may explain the missing significant relation to parental distress, in that discrepant pairs occur rarely. We were not able to build meaningful subgroups due to the small sample size. Moreover, it could well be that an evening-type mother with a morning-type child suffers more stress than a morning-type mother with an evening-type child. Although the recruitment of such subgroups may be difficult and time consuming, we suggest that further research should include more discrepant mother-child dyads as it is seen in the clinical context. Furthermore, we hypothesize that the association between parental distress and mother-child discrepancies in chronotype may depend on the age of the child, in the sense that bigger discrepancies between children's and mothers' chronotype are stronger related to parental distress in younger children than in older.

Finally, although we could show that parental expectations for children's sleep-wake patterns were related to children's chronotype as well as to parental distress, the cross sectional nature of this study does not allow any information about causality.

7. Appendix

7.1. Appendix A: Invitation for Study Participation

KINDERSPITAL ZÜRICH
Universitäts-Kinderklinik · Eleonoren-Stiftung

Abteilung Entwicklungspädiatrie
Kinderspital Zürich
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8032 Zürich

Zürich, Datum

Einladung zur Teilnahme an der Studie
Schlaf- und Aktivitätsverhalten von Eltern und Kindern

Liebe Eltern

Für eine Studie zum Thema Schlaf- und Aktivitätsverhalten von Eltern und Kindern suchen wir Eltern, die bereit wären, mit Ihren Kindern daran teilzunehmen. Wir sind über jede Teilnahme sehr dankbar!

In unserer Studie möchten wir das Schlaf- und Aktivitätsverhalten von gesunden Kindern (im Alter zwischen 4 und 8 Jahren) und Eltern untersuchen. Es soll der Schlaf-Wach-Rhythmus mittels eines Aktimeters, einer Art Uhr, die am Unterarm befestigt wird, und einem Schlaf-Wach-Protokoll über einen Zeitraum von 8 Tagen aufgezeichnet werden. Zusätzlich würden wir gerne im Rahmen eines Interviews ein Elternteil zum Schlaf- und Aktivitätsverhalten befragen und einen Fragebogen über diesbezüglich erlebte Belastungen durchgehen.

Das Schlafverhalten von Eltern und Kindern prägt ihr tägliches Verhalten. Bestehen Schlafschwierigkeiten oder Schlafprobleme, welche bei gesunden Kindern und Eltern häufig vorkommen, so können Veränderungen im Verhalten beobachtet werden.
Diese Studie soll einen Beitrag dazu leisten, Schlafprobleme gesunder Kinder besser zu verstehen, möglichen Ursachen von Belastungen und Schlafprobleme nachzugehen und dadurch eine Hilfestellung für Eltern im Umgang mit Kindern bieten zu können. Weiter möchten wir dem Zusammenwirken von Schlaf und Aktivität nachgehen.

Für die Auswertung der Informationen möchten wir gerne eine Videoaufnahme des Interviews machen. Die Videoaufnahme wird nach der Studienauswertung gelöscht werden. Das Interview findet je nach Möglichkeit bei der Familie zu Hause oder an unserer Abteilung statt. Der zeitliche Aufwand für das Interview beträgt 1-2 Stunden.

Die gesammelten Informationen werden vertraulich und anonym behandelt. Der Ausstieg aus der Studie ist zu jedem Zeitpunkt und ohne nähere Angaben von Gründen möglich. Nach Abschluss der Studie werden wir Ihnen ein Informationsblatt mit den Ergebnissen der Studie zukommen lassen.

Falls Sie bereit sind, diese Studie zu unterstützen und daran teilnehmen möchten, bitten wir Sie, den unten angefügten Anmeldetalon auszufüllen und der Kindergärtnerin Ihres Kindes abzugeben oder an die oben genannte Adresse zu schicken. Wir werden uns dann so bald wie möglich telefonisch bei Ihnen melden, um einen Termin auszumachen. Falls Sie noch Fragen haben, so sind wir gerne bereit, diese zu beantworten oder weitere Details über die Studie mitzuteilen.

Mit freundlichen Grüssen

Dr. O. Jenni
Leitender Arzt
Kinderspital Zürich

H. Werner, lic. phil
Wissenschaftliche Mitarbeiterin
Kinderspital Zürich

✂ ---------- ✂

A n m e l d e t a l o n

Ich bin bereit an der Studie zum Aktivitäts- und Schlafverhalten von Eltern und Kindern teilzunehmen. Bitte nehmen Sie mit mir persönlich Kontakt auf.
Unter der folgenden Adresse und Telefonnummer bin ich am besten erreichbar:

Name der Eltern:	
Name des Kindes:	
Geschlecht des Kindes:	☐ Weiblich ☐ Männlich
Geburtsdatum des Kindes:	
Hauptbezugsperson des Kindes ist:	☐ Mutter ☐ Vater ☐ Andere: _____
Telefonnummer: (und ev. Zeit, wann Sie am besten erreichbar sind)	
Auf die Studie aufmerksam gemacht worden, bin ich über:	

7.2. Appendix B: Informed Consent

KINDERSPITAL ZÜRICH
Universitäts-Kinderklinik · Eleonoren-Stiftung

Elterliches Einverständnis

für die Teilnahme an der Studie „Schlaf- und Aktivitätsverhalten von Eltern und Kindern“

Wir sind damit einverstanden, dass unser Kind zusammen mit einem Elternteil an der oben genannten Studie teilnehmen. Die Details und der Ablauf der Studie wurden uns auf verständliche Art und Weise erklärt. Zusätzlich haben wir eine Kopie der Elterninformation erhalten.
Die Teilnahme an der Studie ist freiwillig. Wir wurden aufgeklärt, dass wir jederzeit und ohne Angaben von näheren Gründen aus dieser Studie austreten können, auch nach Unterschreiben dieser Einverständniserklärung. Die Informationen unseres Kindes und des teilnehmenden Elternteils werden vertraulich und anonym behandelt.
Bei allfälligen Problemen oder Fragen sind die Studienverantwortlichen jederzeit zu erreichen.

Ich/wir, _____ , bin/sind einverstanden,

dass unser/e Sohn/Tochter, _____ , und Mutter/Vater,

_____ , an der oben genannten Studie teilnehmen.

_____	_____	_____
Name (Blockschrift)	Unterschrift	Datum

Die Studie wurde uns von _____ erklärt.

Dr. O. Jenni
Leitender Arzt
Kinderspital Zürich

H. Werner, Psychologin lic. phil
Wissenschaftliche Mitarbeiterin
Kinderspital Zürich

7.3. Appendix C: Actigraphy information

KINDERSPITAL ZÜRICH
Universitäts-Kinderklinik · Eleonoren-Stiftung

Informationen für das Tragen des Aktimeters

Ihre Aktimeternummern:

Kind: _____

Eltern: _____

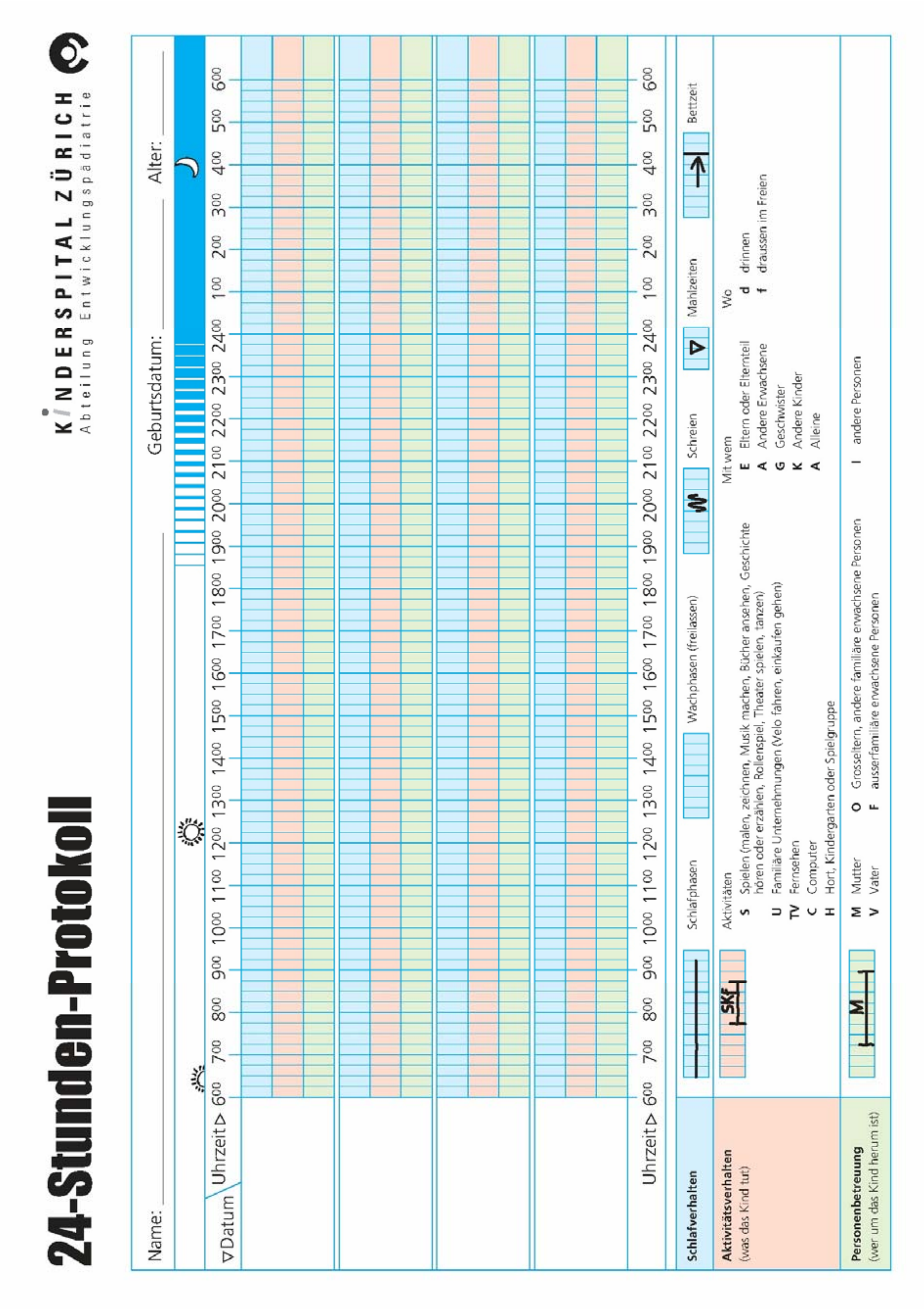
Ihre Aktimeter laufen von: _____

Der Aktimeter soll an 8 aufeinander folgenden Tagen getragen werden (tagsüber und nachts, z.B. von Mo 17 Uhr bis Mo 17 Uhr). Bitte beachten Sie folgende Hinweise:

- Aktimeter darf nicht nass werden. Der Aktimeter muss für's Duschen, Baden, Schwimmen, etc. abgezogen werden
- Aktimeter soll an jener Hand getragen werden, mit der Ihr Kind *nicht* zeichnet oder schreibt (wenn Ihr Kind Rechtshändler ist, dann soll er links getragen werden)
- Batteriefach darf nicht geöffnet werden
- Bitte notieren Sie im Schlafprotokoll, wenn
    - Sie/das Kind während des Tragens des Aktimeters stark erkältet oder krank waren/war
    - Sie/das Kind den Aktimeter abgezogen haben/hat
    - Sie/das Kind mit dem Auto oder Bus unterwegs waren/war
- Bitte schicken Sie die Aktimeter nach dem Tragen mit dem beigelegten Kuvert an uns zurück

Vielen Dank!

7.4. Appendix D: Children's sleep-wake diary



24-Stunden-Protokoll

KINDERSPITAL ZÜRICH
Abteilung Entwicklungspädiatrie

Name: ____ Geburtsdatum: ____ Alter: ____

▽Datum | Uhrzeit ▷ 6⁰⁰ 7⁰⁰ 8⁰⁰ 9⁰⁰ 10⁰⁰ 11⁰⁰ 12⁰⁰ 13⁰⁰ 14⁰⁰ 15⁰⁰ 16⁰⁰ 17⁰⁰ 18⁰⁰ 19⁰⁰ 20⁰⁰ 21⁰⁰ 22⁰⁰ 23⁰⁰ 24⁰⁰ 1⁰⁰ 2⁰⁰ 3⁰⁰ 4⁰⁰ 5⁰⁰ 6⁰⁰

Schlafverhalten
Schlafphasen — Wachphasen (freilassen) — Schreien — Mahlzeiten — Bettzeit

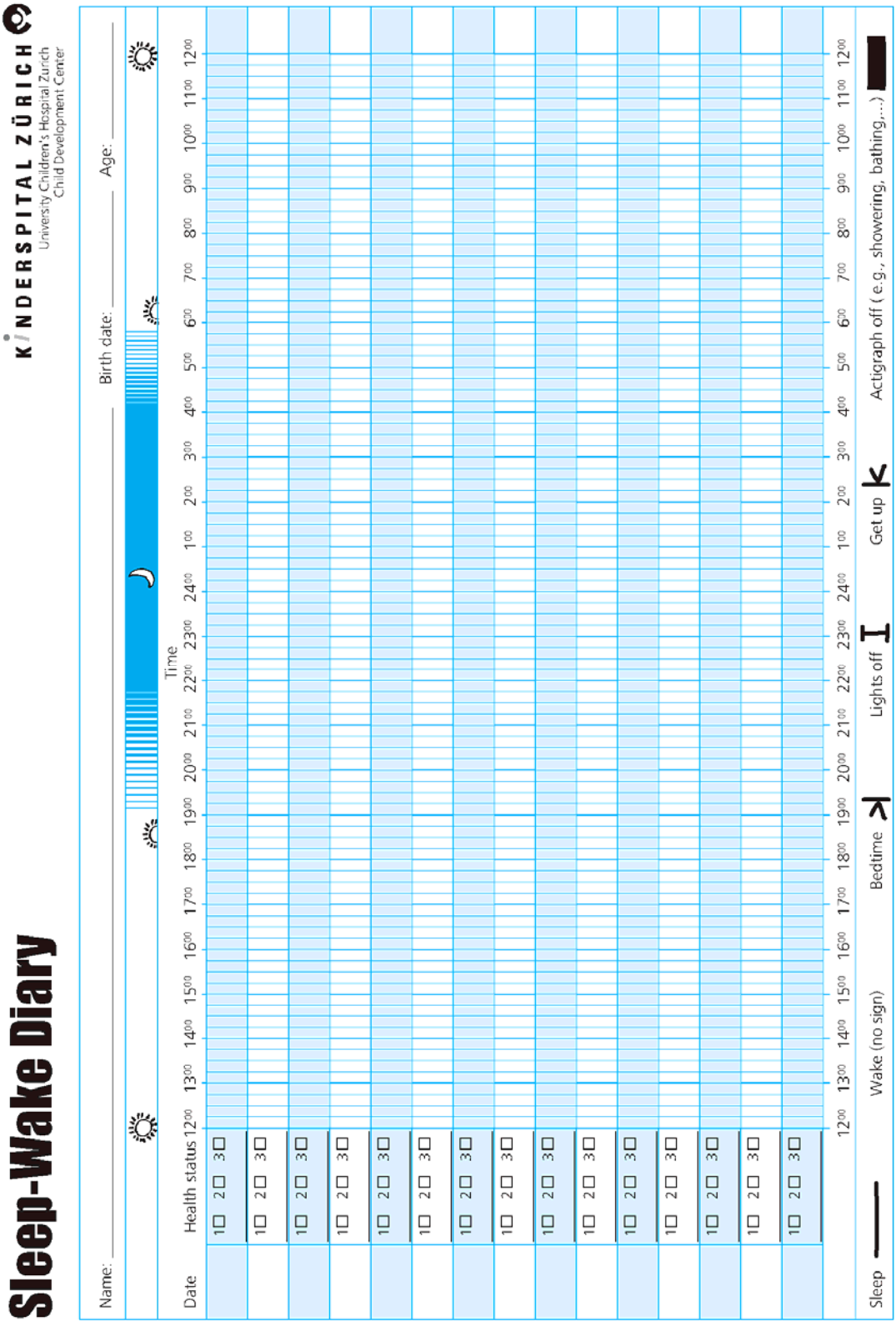
Aktivitätsverhalten (was das Kind tut)
Aktivitäten
S Spielen (malen, zeichnen, Musik machen, Bücher ansehen, Geschichte hören oder erzählen, Rollenspiel, Theater spielen, tanzen)
U Familiäre Unternehmungen (Velo fahren, einkaufen gehen)
TV Fernsehen
C Computer
H Hort, Kindergarten oder Spielgruppe

Mit wem
E Eltern oder Elternteil
A Andere Erwachsene
G Geschwister
K Andere Kinder
A Alleine

Wo
d drinnen
f draussen im Freien

Personenbetreuung (wer um das Kind herum ist)
M Mutter
V Vater
O Grosseltern, andere familiäre erwachsene Personen
F ausserfamiliäre erwachsene Personen
I andere Personen

7.5. Appendix E: Parents' sleep-wake diary



7.6. Appendix F: Interview

Datenerfassungsblatt Anamnese Kind

Daten über die Geburt des Kindes (nach Geburtsheft fragen)

Wurde Ihr Kind am Termin geboren? (über 37. Schwangerschaftswoche)
Geburtsgewicht:
Geburtsgrösse:
Kopfumfang:
Gab es Schwangerschafts- oder Geburtskomplikationen?

Wie ging es mit dem Ernährungs- und Schlafrhythmus in den ersten Lebensjahren?

War Ihr Kind ein Schreikind?

Wurde Ihr Kind gestillt? für wie lange?

Wurde Ihr Kind jemals wegen einer oder mehreren somatischen Krankheiten ärztlich behandelt? (z.B. Asthma, Herzprobleme, Dermatitis, Hormonstörungen)

wenn ja, was war? Veränderte sich dadurch das Schlaf- und Aktivitätsverhalten?
wenn ja, nimmt Ihr Kind ärztlich verschriebene Medikamente?

Hatte Ihr Kind *im letzten Jahr* eine schwere Krankheit, eine Operation oder starke körperliche Beschwerden?

Wurde Ihr Kind jemals wegen einer oder mehreren Verhaltensauffälligkeiten behandelt? (z.B. Hyperaktivität, Aufmerksamkeitsprobleme, Angststörungen)

wenn ja, was war? Veränderte sich dadurch das Schlaf- und Aktivitätsverhalten?
wenn ja, nimmt Ihr Kind ärztlich verschriebene Medikamente?

Wurde bei Ihrem Kind jemals eine Schlafstörung diagnostiziert? (PA, Schlaf)
wenn ja, in welchem Alter? Was war?

Wurde bei jemandem in der Familie (Mutter, Vater, Geschwister, Grosseltern) jemals eine Schlafstörung diagnostiziert? (FA, Schlaf)
wenn ja, in welchem Alter? Was war?

Was ist die Muttersprache des Kindes?

Ist das Kind mehrsprachig aufgewachsen?

Wie würden Sie das Schlafverhalten Ihres Kindes während des letzten Monates beschreiben? ☐ sehr regelmässig ☐ etwas regelmässig ☐ nicht regelmässig

Wie würden Sie Ihr eigenes Schlafverhalten während des letzten Monates beschreiben?
☐ sehr regelmässig, ☐ etwas regelmässig, ☐ nicht regelmässig

Datenerfassungsblatt allgemeine Informationen zum Schlafverhalten Kind

1. Geht Ihr Kind unter der Woche jeweils abends **regelmässig** ins Bett?

☐ Ja ☐ Nein Wie oft variiert es in der Woche? _____

Stellt dies ein Problem dar? ☐ Ja ☐ Nein

Wenn ja, ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

2. Hat Ihr Kind ein **regelmässiges** Einschlafritual (allabendliche gleiche Reihenfolge von Handlungen vor dem Insbettgehen)?

☐ Ja; Welches? _____

Wie lange dauert dieses Einschlafritual? ____ Min.

☐ Nein

3. Hat Ihr Kind ein Schlafobjekt (z.B. Nuscheli, Stofftier, Puppe, etc.)?

☐ Ja; Welches? _____

☐ Nein

4. Hat Ihr Kind ein eigenes Schlafzimmer?

☐ Ja

☐ Nein; Mit wem teilt es das Schlafzimmer?

_____

Hat Ihr Kind ein eigenes Bett?

☐ Ja

☐ Nein; Mit wem teilt es das Bett?

_____

5. Wo schläft Ihr Kind normalerweise ein?

☐ im eigenen Bett im eigenen Schlafzimmer

☐ im Elternbett im Schlafzimmer der Eltern

☐ auf dem Sofa im Wohnzimmer

☐ im Spielzimmer

☐ Andere:_____

6. Wie viele Minuten verbringt Ihr Kind vor dem Einschlafen in jenem Zimmer, in dem es danach einschläft?

_____ Minuten

7. Braucht Ihr Kind die elterliche Präsenz um einschlafen zu können? ☐ ja ☐ nein

8. Was ist die *früheste* Zeit, wann Ihr Kind während einer normalen Woche (geregelte Tage) ins Bett geht?

Um ____ : ____ Uhr

9. Was ist die *späteste* Zeit, wann Ihr Kind während einer normalen Woche (geregelte Tage) ins Bett geht?

Um ____ : ____ Uhr

10. Was ist die *früheste* Zeit, wann Ihr Kind am Morgen während einer normalen Woche (geregelte Tage) aufwacht?

Um ____ : ____ Uhr

11. Was ist die *späteste* Zeit, wann Ihr Kind am Morgen während einer normalen Woche (geregelte Tage) aufwacht?

Um ____ : ____ Uhr

12. Schläft Ihr Kind die meiste Zeit in der Nacht alleine oder mit jemandem zusammen?

☐ Alleine ☐ mit _____

13. Weigert sich Ihr Kind *normalerweise* am Abend ins Bett zu gehen? ☐ Ja ☐ Nein

Gibt es Zeiten, in welchen Ihr Kind sich weigert ins Bett zu gehen? In welchen Situationen kommt dies vor?

Was ist der *häufigste Grund* dafür, dass es sich weigert ins Bett zu gehen?

_____

Wann ist es das letzte Mal vorgekommen?

_____

Wie häufig kommt es vor, dass Ihr Kind sich weigert ins Bett zu gehen? insgesamt: häufig/manchmal/selten

pro Woche: _____ pro Monat: _____

Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

14. Hat Ihr Kind *normalerweise* Mühe einzuschlafen? ☐ Ja ☐ Nein

14a. *wenn ja,* was ist nach Ihrer Ansicht der häufigste Grund dafür?

_____

14b. *wenn ja*, wie häufig kommt es vor, dass Ihr Kind Mühe hat einzuschlafen? insgesamt: häufig/manchmal/selten

pro Woche: _____ pro Monat: _____

14c. Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

14d. *wenn ja,* was wird normalerweise gemacht bzw. unternommen, dass das Kind dann doch einschläft?

_____

_____

15. Bekommt Ihr Kind zum jetzigen Zeitpunkt Schlafmedikamente? ☐ Ja ☐ Nein

Hat Ihr Kind schon einmal Schlafmedikamente bekommen? ☐ Ja ☐ Nein

15a. *Wenn ja*, welche? _____ Wie häufig? _____

15b. *wenn ja*, was ist der Effekt? _____

16. Ist Ihr Kind ein Kurzschläfer? (weniger als ca. 10h Schlaf/Nacht) ☐ Ja ☐ Nein ☐ Manchmal

16a. Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

17. Ist Ihr Kind ein Langschläfer? (mehr als ca. 12h Schlaf/Nacht) ☐ Ja ☐ Nein ☐ Manchmal

17a. Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

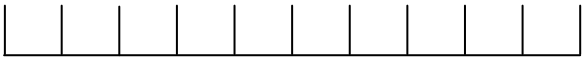
☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

18. Wie aktiv ist bzw. wie stark bewegt sich Ihr Kind (durchschnittlich) am Abend während den letzten 30 Minuten bevor es einschläft?



sehr aktiv sehr inaktiv

19. *Zum jetztigen Zeitpunkt*: Schnarcht oder atmet Ihr Kind schwer, während dessen es schläft?

☐ Ja; ☐ selten ☐ manchmal/ab und zu ☐ sehr häufig/immer

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

Vergangenheit: Hat Ihr Kind schon einmal geschnarcht oder schwer geatmet? Wann war das (Alter)?

_____

☐ Ja; ☐ selten ☐ manchmal/ab und zu ☐ sehr häufig/immer

☐ Nein

War dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

20. Schlafwandeln: Haben Sie schon einmal beobachtet, dass Ihr Kind schlafwandelt?

☐ Ja; ☐ selten ☐ manchmal/ab und zu ☐ sehr häufig/immer

Wenn ja, wie alt war das Kind?

_____

☐ Nein

War dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

21. Wacht Ihr Kind *normalerweise* in der Nacht auf? ☐ Ja ☐ Nein

Wann ist es das letzte Mal aufgewacht in der Nacht?

_____

Gab es einen Grund?

_____

Was ist der häufigste Grund fürs nächtliche Aufwachen? (z.B. Kranksein, am Tag viel unternommen)

_____

Wie häufig kommt es vor, dass Ihr Kind in der Nacht aufwacht? pro Woche: ____ pro Monat: _____

Verwacht Ihr Kind *normalerweise* mehrmals in der Nacht? ☐ Ja; wie oft durchschnittlich: ____ ☐ Nein

Wie verhält sich Ihr Kind meistens, nachdem es in der Nacht aufgewacht ist? (z.B. ruft nach den Eltern, geht ins Zimmer der Eltern, Schreien)

_____
_____

Stellt dieses Verhalten Ihres Kindes ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

Wie verhalten Sie sich als Eltern meistens, nachdem Ihr Kind in der Nacht aufgewacht ist? (z.B. auf den Arm nehmen, sich zum Kind hinlegen)

_____

Wer geht *gewöhnlich/meistens* zum Kind? (Mu, Va, abwechselnd)?

_____

Zieht das Kind jemand von Ihnen als Eltern vor? (Mu, Va, keine Präferenz)

_____

Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

Hat Ihr Kind, nach dem es in der Nacht aufgewacht ist, Mühe wieder einzuschlafen?

☐ Ja; ☐ immer ☐ manchmal ☐ selten ☐ Nein

Wie lange braucht es durchschnittlich, um wieder einzuschlafen? _____ Min.

Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

22. Hat Ihr Kind *normalerweise* eine Aufwachstörung in der Nacht (z.B. Angstschreck)?

☐ Ja; wie häufig kommt dies vor? pro Woche: _____ pro Monat: _____

☐ Nein

Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

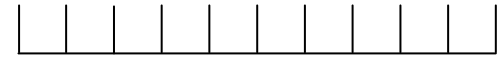
☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

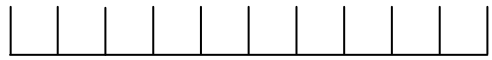
23. Wie gut schneidet Ihr Kind durchschnittlich bei den unten genannten Situationen ab? Bitte kreuzen Sie auf einer Skala von „sehr gut“ bis „sehr schwach“ an.

zu Schlafzeiten ins Bett gehen

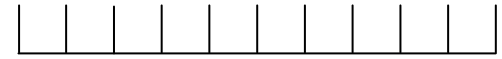
„direktes“ Einschlafen (5-10min.) nachdem das Licht ausgelöscht wurde



die Nacht durchschlafen

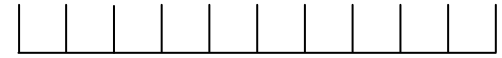


„Direktes“ Wiedereinschlafen (5-10min.), nach dem das Kind in der Nacht aufgewacht ist



am Morgen aufstehen

Schlaf insgesamt (Schlafqualität)



Datenerfassungsblatt elterliche Erwartungen an Schlafverhalten Kind

Vorstellungen der Eltern an den kindlichen Schlaf
…wie das Kind schlafen sollte…

In welchem Ausmass stimmen Sie folgenden Aussagen zu?

		überhaupt nicht	**kaum/wenig**	**etwas**	**ziemlich**	**ganz genau/sehr**
1.	Mein Kind sollte immer zur gleichen Zeit ins Bett gehen					
	unter der Woche	1	2	3	4	5
	am Wochenende	1	2	3	4	5
2.	Mein Kind sollte jeweils abends ohne Weigerung ins Bett gehen	1	2	3	4	5
3.	Mein Kind sollte immer in seinem Bett schlafen (einschlafen wie durchschlafen)	1	2	3	4	5
4.	Mein Kind sollte jeweils gleich einschlafen (ohne Mühe, innerhalb 10 min.), nachdem die Lichter gelöscht wurden	1	2	3	4	5
5.	Mein Kind sollte ein regelmässiges Einschlafritual haben	1	2	3	4	5
6.	Mein Kind sollte immer ohne elterliches Beisein einschlafen	1	2	3	4	5
7.	Mein Kind sollte sich nicht mehr so stark körperlich bewegen während den letzten 30 Min. bevor es einschläft	1	2	3	4	5
8.	Mein Kind sollte jede Nacht durchschlafen bzw. nicht aufwachen	1	2	3	4	5
9.	Mein Kind sollte sich ruhig verhalten, wenn es in der Nacht aufwacht	1	2	3	4	5
10.	Mein Kind sollte gleich (ohne Mühe, innerhalb 10 min.) nach nächtlichem Erwachen wieder einschlafen	1	2	3	4	5
11.	Mein Kind sollte am Morgen von sich aus aufwachen (ohne Wecker, ohne rufen)	1	2	3	4	5
12.	Mein Kind sollte am Morgen ohne Schwierigkeiten geweckt werden können	1	2	3	4	5
13.	Mein Kind sollte einen Mittagsschlaf halten					
	unter der Woche	1	2	3	4	5
	am Wochenende	1	2	3	4	5
14.	Mein Kind sollte früh ins Bett und früh aufstehen	1	2	3	4	5
15.	Mein Kind sollte spät ins Bett und spät aufstehen	1	2	3	4	5

16.	Zu welchem Zeitpunkt sollte Ihr Kind ins Bett gehen? (nicht Beginn der Ins-Bett-Geh-Vorbereitungen)	
	a) an Abenden vor und von *geregelten* Wochentagen	_____Uhr
	b) an Abenden vor und von *freien* Tagen	_____Uhr
	c) an Abenden vor und von *Ferien*tagen	_____Uhr
17.	Zu welchem Zeitpunkt sollten die Lichter gelöscht werden? (Zeitpunkt wann Kind bereit zum einschlafen sein sollte)	
	a) an Abenden vor und von *geregelten* Wochentagen	_____Uhr
	b) an Abenden vor und von *freien* Tagen	_____Uhr
	c) an Abenden vor und von *Ferien*tagen	_____Uhr
18.	Wie lange sollte Ihr Kind Ihrer Meinung nach brauchen, um einzuschlafen?	_____Min.
19.	Wie lange sollte Ihr Kind Ihrer Meinung nach brauchen, um nach nächtlichem Erwachen wieder einzuschlafen?	_____Min
20.	Zu welchem Zeitpunkt sollte Ihr Kind Ihrer Meinung nach morgens aufwachen?	
	a) an *geregelten* Wochentagen	_____Uhr
		_____Uhr
	b) an *freien* Tagen	_____Uhr
	c) an *Ferien*tagen	
21.	Zu welchem Zeitpunkt sollte Ihr Kind morgens aufstehen?	
	a) an *geregelten* Wochentagen	_____Uhr
	b) an *freien* Tagen	_____Uhr
	c) an Ferientagen	_____Uhr
22.	Zu welchem Zeitpunkt sollte Ihr Kind Ihrer Meinung nach hell wach sein?	_____Uhr
	a) an *geregelten* Wochentagen	_____Uhr
	b) an *freien* Tagen	_____Uhr
	c) an Ferientagen	
23.	Sollte Ihr Kind einen Mittagsschlaf halten?	
	a) an *geregelten* Wochentagen	☐ ja ☐ nein
	b) an *freien* Tagen	☐ ja ☐ nein
	c) an Ferientagen	☐ ja ☐ nein
	Wenn ja, zu welchem Zeitpunkt sollte Ihr Kind einen Mittagsschlaf halten?	_____Uhr
	a) an *geregelten* Wochentagen	_____Uhr
	b) an *freien* Tagen	_____Uhr
	c) an *Ferien*tagen	
	Wenn ja, für wie lange sollte Ihr Kind Ihrer Meinung nach einen Mittagsschlaf machen?	_____Min.
	a) an geregelten Wochentagen	_____Min
	b) an freien Tagen	_____Min.
	c) an Ferientagen	

Wenn Sie von einer normalen Woche des Kindes ausgehen, wie viele Stunden sollte Ihr Kind mindestens in den unten genannten Nächten schlafen, damit es Ihrer Meinung nach am nächsten Tag fit, bzw. leistungs- und konzentrationsfähig, bzw. bei guter Laune ist?

24.	**In Nächten an geregelten Tagen durchschnittlich: _____ h**	**In Nächten an freien Tagen durchschnittlich: _____ h**

Datenerfassungsblatt allgemeine Informationen zum Schlafverhalten Mutter

1. Wenn Sie könnten …

… an wie vielen Abende in der Woche (ohne Wochenende) *würden* Sie später ins Bett gehen als normalerweise?

⓪ ① ② ③ ④ ⑤ ⑥

… an wie vielen Morgen in der Woche (ohne Wochenende) *würde*n Sie später aufstehen als normalerweise?

⓪ ① ② ③ ④ ⑤ ⑥

2. Was ist die *früheste* Zeit, zu der Sie während einer normalen Arbeitswoche ins Bett gehen?

Um ____ : ____ Uhr

3. Was ist die *späteste* Zeit, zu der Sie während einer normalen Arbeitswoche ins Bett gehen?

Um ____ : ____ Uhr

4. Schlafen Sie am besten in einem völlig abgedunkelten Raum? ☐ Ja ☐ Nein

5. Was ist die *früheste* Zeit, zu der Sie am Morgen während einer normalen Arbeitswoche aufwachen?

Um ____ : ____ Uhr

6. Was ist die *späteste* Zeit, zu der Sie am Morgen während einer normalen Arbeitswoche aufwachen?

Um ____ : ____ Uhr

7. Wachen Sie besser auf, wenn morgens Licht ins Zimmer scheint? ☐ Ja ☐ Nein

8. Wo schlafen Sie normalerweise ein?

☐ im eigenen Bett

☐ auf dem Sofa im Wohnzimmer

☐ Andere:_____

9. Wie viele Minuten verbringen Sie vor dem Einschlafen in jenem Zimmer, in dem Sie danach einschlafen?

_____ Minuten

10. Haben Sie ein regelmässiges Einschlafritual (eine immer wiederkehrende Abfolge von Handlungen, die Sie vor dem ins Bettgehen machen)? ☐ Ja ☐ Nein

8a. *Wenn ja*, welches?

_____

11. Wenn ja, wie lange dauert dieses Einschlafritual? ____ Minuten

12. Haben Sie *normalerweise* Mühe einzuschlafen? ☐ Ja ☐ Nein

12a. *Wenn ja*, an wie vielen Abende in der Woche kommt dies (durchschnittlich) vor? _____

12b. Stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Manchmal; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Manchmal; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

12c. *Wenn ja*, was machen Sie, dass Sie dann trotzdem einschlafen? _____

12d. Nehmen Sie jeweils etwas Einschlafförderndes zu sich? ☐ Ja ☐ Nein

12e. *Wenn ja*, was? _____

13. Wachen Sie *normalerweise* in der Nacht auf? ☐ Ja ☐ Nein

13a. *Wenn ja*, was ist der häufigste Grund dafür?

☐ Kind ruft nach mir ☐ Toilettengang ☐ Lärm ☐ Andere: _____

13a. *Wenn ja*, an wie vielen Nächte in der Woche kommt dies (durchschnittlich) vor? _____

13b. *Wenn ja*, stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Manchmal; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Manchmal; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

13c. *Wenn ja*, haben Sie Mühe, danach wieder einzuschlafen? ☐ Ja ☐ Nein ☐ Manchmal

13d. *Wenn ja*, stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Manchmal; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Manchmal; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

14. Ist es schwierig, Sie am Morgen jeweils zu wecken bzw. hören Sie jeweils den Wecker nicht?
☐ Ja ☐ Nein ☐ Manchmal

14a. *Wenn ja bzw. manchmal*, stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Manchmal; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Manchmal; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

15. Sind Sie ein Langschläfer? (mehr als ca. 9h Schlaf/Nacht) ☐ Ja ☐ Nein ☐ Manchmal

15a. *Wenn ja bzw. manchmal*, stellt dies ein Problem dar?

☐ Ja; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Manchmal; ☐ kleines Problem ☐ mittleres Problem ☐ grosses Problem

☐ Nein

Ist dies belastend für Sie?

☐ Ja; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Manchmal; sehr leicht ① ② ③ ④ ⑤ sehr stark

☐ Nein

15b. *Wenn ja*, weshalb stellt dies ein Problem dar? _____

16. Wie schneiden Sie im Durchschnitt bei den unten genannten Verhaltensweisen ab? Bitte kreuzen Sie auf einer Skala von „sehr gut“ bis „sehr schwach“ an.

Ins Bett gehen wann ich mir vorgenommen hatte ins Bett zu gehen

sehr schwach — sehr gut

direktes Einschlafen nachdem das Licht ausgelöscht wurde

sehr schwach — sehr gut

die Nacht durchschlafen

sehr schwach — sehr gut

wieder einschlafen, nach dem ich in der Nacht aufgewacht bin

sehr schwach — sehr gut

am Morgen aufstehen

sehr schwach — sehr gut

Schlaf insgesamt (Schlafqualität)

sehr schwach — sehr gut

17. Wie aktiv ist bzw. wie stark bewegen Sie sich (durchschnittlich) am Abend während den letzten 30 Minuten bevor Sie einschlafen?

sehr aktiv — sehr inaktiv

Datenerfassungsblatt Sozioökonomischer Status (SES)

Demographische Angaben zur Kindsmutter

Aktuelles Datum:	
Alter in Jahre:	
Geschlecht:	☐ weiblich ☐ männlich
Nationalität:	☐ Schweizer ☐ Nicht-Schweizer
Zivilstand:	☐ verheiratet ☐ geschieden/getrennt ☐ ledig, noch nie verheiratet ☐ verwitwet
Haushalt:	☐ allein lebend ☐ zusammenlebend mit Ehe-/Lebenspartner(in) ☐ in Wohngemeinschaft lebend ☐ bei Eltern oder Verwandten lebend
Höchster Schulabschluss:	☐ Ohne Schulabschluss (Sonderschule oder nicht abgeschlossene Mindestausbildung) ☐ Abschluss obligater Mindestschulzeit des jeweiligen Kantons/Landes ☐ mittlerer Abschluss Oberstufe (ZH: Realschule; AG: Sekundarschule) oder 1-2jährige Berufslehre mit Abschluss ☐ höherer Abschluss Oberstufe (ZH: Sekundarschule; AG: Bezirksschule)oder 3-4jährige Berufslehre mit Abschluss ☐ Matura, Technikum, Seminar ☐ Fachhochschule ☐ Universität, ETH ☐ Andere:
Was haben Sie für einen Beruf gelernt?	
Berufsausbildung:	☐ ungelernt ☐ angelernt ☐ 2jährige Lehre mit Diplom, Abendschule mit Diplom ☐ 3-4 jährige Lehre mit Diplom, Handelsschule mit Diplom ☐ Abschluss Seminar/Oberseminar mit Diplom ☐ Fachhochschule, Technikum mit Diplom ☐ Bachelor ☐ Liz/Master an Universität, ETH ☐ Andere:
Sind Sie berufstätig? …	☐ Ja, ___ % ☐ Ja, mithelfend im eigenen Betrieb ___ % ☐ Nein
…und/oder sind Sie:	☐ Student ☐ in Berufsausbildung ☐ Rentner(in), Ruhestand ☐ zurzeit arbeitslos ☐ Hausfrau/Hausmann ☐ keines von dem

Demographische Angaben zum Kindsvater

Aktuelles Datum:	
Alter in Jahre:	
Geschlecht:	☐ weiblich ☐ männlich
Nationalität:	☐ Schweizer ☐ Nicht-Schweizer
Zivilstand:	☐ verheiratet ☐ geschieden/getrennt ☐ ledig, noch nie verheiratet ☐ verwitwet
Haushalt:	☐ allein lebend ☐ zusammenlebend mit Ehe-/Lebenspartner(in) ☐ in Wohngemeinschaft lebend ☐ bei Eltern oder Verwandten lebend
Höchster Schulabschluss:	☐ Ohne Schulabschluss (Sonderschule oder nicht abgeschlossene Mindestausbildung) ☐ Abschluss obligater Mindestschulzeit des jeweiligen Kantons/Landes ☐ mittlerer Abschluss Oberstufe (ZH: Realschule; AG: Sekundarschule) oder 1-2jährige Berufslehre mit Abschluss ☐ höherer Abschluss Oberstufe (ZH: Sekundarschule; AG: Bezirksschule)oder 3-4jährige Berufslehre mit Abschluss ☐ Matura, Technikum, Seminar ☐ Fachhochschule ☐ Universität, ETH ☐ Andere:
Was haben Sie für einen Beruf gelernt?	
Berufsausbildung:	☐ ungelernt ☐ angelernt ☐ 2jährige Lehre mit Diplom, Abendschule mit Diplom ☐ 3-4 jährige Lehre mit Diplom, Handelsschule mit Diplom ☐ Abschluss Seminar/Oberseminar mit Diplom ☐ Fachhochschule, Technikum mit Diplom ☐ Bachelor ☐ Liz/Master an Universität, ETH ☐ Andere:
Sind Sie berufstätig? …	☐ Ja, ___ % ☐ Ja, mithelfend im eigenen Betrieb ___ % ☐ Nein
…und/oder sind Sie:	☐ Student ☐ in Berufsausbildung ☐ Rentner(in), Ruhestand ☐ zurzeit arbeitslos ☐ Hausfrau/Hausmann ☐ keines von dem

7.7. Appendix G: Questionnaires

Children's ChronoType Questionnaire (CCTQ) – deutsche Version

In einem ersten Teil werden allgemeine demographische Informationen erhoben, in einem zweiten Teil geht es um das Schlafverhalten Ihres Kindes _____. Bitte beantworten Sie die folgenden Fragen oder wählen Sie die bestmögliche Antwort.

1. Bitte geben Sie an, wer den Fragebogen ausfüllt: ☐ Mutter ☐ Vater ☐ Andere: _____

2. heutiges Datum: ___ / ___ / _____ (Tag/Monat /Jahr)

3. Geburtsdatum des Kindes: ___ / ___ / _____ (Tag/Monat/Jahr)

4. Alter des Kindes in Jahre: ____ Jahre

5. Geschlecht des Kindes: ☐ Männlich ☐ Weiblich

6. Körpergrösse des Kindes: ____ Meter

7. Gewicht des Kindes: _____ Kilogramm

8. Ist das Kind ein Einzelkind? ☐ Ja ☐ Nein: wie viele Kinder sind in Ihrer Kern-Familie? ___ _

   Haben alle Geschwister die gleichen biologischen Eltern? ☐ Ja ☐ Nein: _____

   Welche Geburtsposition hat das Kind in der Geschwisterreihe inne? ___
   (bei Zwilling, bitte geben Sie an, ob er Erstgeborener oder Zweitgeborener ist)

   welches Alter und welches Geschlecht haben die Geschwister?
   Geschwister A ist _____ Jahre alt und *männlich/weiblich* (bitte zutreffendes unterstreichen)
   Geschwister B ist _____ Jahre alt und *männlich/weiblich*
   Geschwister C ist _____ Jahre alt und *männlich/weiblich*
   Geschwister D ist _____ Jahre alt und *männlich/weiblich*

9. Besucht das Kind bereits die Schule? ☐ Ja ☐ Nein

9a. *wenn ja*, an wie vielen Tagen in der Woche? __ 9b. Wie viele Stunden (durchschnittlich) am Tag? _____

9c. *wenn nein*, besucht das Kind ☐ Kindergarten ☐ Kinderkrippe ☐ Spielgruppe ☐ Anderes: _____?
Wie viele Stunden (durchschnittlich) am Tag? _____

10. Wer ist die Hauptbezugsperson des Kindes? _____

11. Wird das Kind von ausser(kern-)familiären Personen betreut? ☐ Ja; von wem? _____ ☐ Nein

11a. *wenn ja,* wie viele Tage in der Woche? ___ 10b. Wie viele Stunden (durchschnittlich) am Tag? _____

Die folgenden Fragen richten sich an das Schlafverhalten Ihres Kindes an geregelten Tagen (z.B. während des Kindergartens) und an freien Tagen (z.B. am Wochenende). Bitte denken Sie beim Beantworten der folgenden Fragen bezüglich geregelten Tagen an das Verhalten Ihres Kindes *während des letzten Monates* und beim Beantworten der Fragen bezüglich freien Tagen *an die zuletzt verbrachten Ferien*. Wenn das Schlafverhalten Ihres Kindes an geregelten Tagen durch verschiedene Tagesbedingungen bestimmt wird, so geben Sie bitte das am häufigsten vorkommende Verhalten als Antwort an.

Geregelte Tage

Wie verhält sich Ihr Kind an Tagen, an denen der Schlaf-Wach-Rhythmus des Kindes direkt durch individuelle oder familiäre Aktivitäten beeinflusst wird, wie z.B. durch den Kindergarten, durch Tagesbetreuung oder durch Sport?

An geregelten Tagen, mein Kind …

12. …wacht normalerweise um ____ : ____ Uhr auf.

13. …wacht meistens ☐ selber ☐ durch ein Familienmitglied (Mu/Va) ☐ mittels Wecker auf.

14. …steht normalerweise um ____ : ____ Uhr auf.

15. …ist normalerweise hell wach um ____ : ____ Uhr.

16. …macht normalerweise (an geregelten Tagen) einen Mittagsschlaf: ☐ Ja ☐ Nein

wenn ja,	*wenn nein,*
an wie vielen geregelten Tagen in der Woche? _____	weshalb macht Ihr Kind keinen Mittagsschlaf mehr? _____
zu welcher Zeit macht es normalerweise einen Mittagsschlaf? Wann steht es wieder auf? von ____ : ____ Uhr bis ____ : ____ Uhr Und falls das Kind mehrmals am Tag schläft: von ____ : ____ Uhr bis ____ : ____ Uhr	was macht Ihr Kind nach dem Mittagessen? _____ _____ _____ _____ _____ _____

An Abende vor geregelten Tagen…

17. … geht mein Kind normalerweise um ____ : ____ Uhr ins Bett.
(Zeitpunkt, wann das Kind wirklich im Bett liegt)

18. … ist mein Kind normalerweise um ____ : ____ Uhr bereit einzuschlafen.
(Zeitpunkt, wann die Lichter gelöscht werden)

19. …braucht mein Kind normalerweise ____ Minuten, um einzuschlafen.
(Zeitspanne zwischen dem Zeitpunkt, wann die Lichter gelöscht werden und dem Zeitpunkt, wann das Kind eingeschlafen ist)

Freie Tage

Wie verhält sich Ihr Kind an Tagen, an denen der Schlaf-Wach-Rhythmus Ihres Kindes nicht durch individuelle oder familiäre Aktivitäten beeinflusst wird, wie z.B. durch den Kindergarten, durch Tagesbetreuung oder durch Sport?

An freien Tagen, mein Kind …

20. …wacht normalerweise auf um ____ : ____ Uhr

…wacht meistens ☐ selber ☐ durch ein Familienmitglied (Mu/Va) ☐ mittels Wecker auf.

…wacht normalerweise zur selben Zeit wie an geregelten Tagen auf und schläft dann nochmals ein?

☐ Ja ☐ Nein *Wenn ja,* für wie lange schläft das Kind nochmals? ____ Minuten

21. … steht (an freien Tagen) normalerweise um ____ : ____ Uhr auf.

22. …ist normalerweise hell wach um ____ : ____ Uhr.

23. …macht normalerweise (an freien Tagen) einen Mittagsschlaf: ☐ Ja ☐ Nein

wenn ja,	*wenn nein,*
an wie vielen freien Tagen in der Woche? _____	weshalb macht Ihr Kind keinen Mittagsschlaf mehr? _____
zu welcher Zeit macht es normalerweise einen Mittagsschlaf? Wann steht es wieder auf? von ____ : ____ Uhr bis ____ : ____ Uhr Und falls das Kind mehrmals am Tag schläft: von ____ : ____ Uhr bis ____ : ____ Uhr	was macht Ihr Kind nach dem Mittagessen? _____ _____ _____ _____ _____ _____

An Abenden vor freien Tagen…

24. … geht mein Kind normalerweise ins Bett um ____ : ____ Uhr.

(Zeitpunkt, wann das Kind wirklich im Bett liegt)

25. … ist mein Kind normalerweise bereit einzuschlafen um ____ : ____ Uhr.

(Zeitpunkt, wann die Lichter gelöscht werden)

26. …braucht mein Kind normalerweise _____ Minuten um einzuschlafen.

(Zeitspanne zwischen dem Zeitpunkt, wann die Lichter gelöscht werden und dem Zeitpunkt, wann das Kind eingeschlafen ist)

Bitte wählen Sie für das Beantworten der folgenden Fragen jene Antwort aus, die Ihr Kind bestmöglich beschreibt. Beantworten sie bitte *jede* Frage und entscheiden Sie sich immer (wenn nicht anders erwähnt) im Hinblick darauf, wie sich Ihr Kind *im letzten Monat* verhalten hat. Verlieren Sie nicht zuviel Zeit beim Überlegen. Geben Sie die erste spontane Antwort, die Ihnen einfällt. Es gibt keine richtigen oder falschen Antworten!

27. *Wenn Ihr Kind am Morgen geweckt werden muss: Wie leicht bzw. schwer finden Sie es, Ihr Kind am Morgen normalerweise zu wecken?
    a. sehr schwer
    b. eher schwer
    c. mittelmässig schwer
    d. wenig schwer
    e. nicht schwer/mein Kind muss nie geweckt werden

28. *Wie wach ist Ihr Kind jeweils während der ersten halben Stunde nach dem Aufwachen am Morgen?
    a. überhaupt nicht wach
    b. wenig wach
    c. mittelmässig wach
    d. eher wach
    e. sehr wach

29. Wenn Sie das Wohlempfinden Ihres Kindes betrachten, zu welcher Tageszeit *würde* Ihr Kind **aufstehen**, wenn es selber entscheiden könnte und den ganzen Tag frei hätte (z.B. Ferien)?
    a. vor 6:30
    b. 06:30 - 7:14
    c. 7:15 - 9:29
    d. 9:30 - 10:14
    e. nach 10:15

30. Wenn Sie das Wohlempfinden Ihres Kindes betrachten, zu welcher Tageszeit *würde* Ihr Kind **ins Bett gehen**, wenn es selber entscheiden könnte, jedoch am nächsten Tag frei hätte (z.B. Wochenende)?
    a. vor 18:59
    b. 19:00 - 19:59
    c. 20:00 - 21:59
    d. 22:00 - 22:59
    e. nach 23:00

31. Nehmen Sie an, Ihr Kind *müsste* sich beispielsweise für eine Aufgabe oder ein Spiel für *zwei* Stunden konzentrieren können. Sie möchten, dass Ihr Kind für diese zwei Stunden in Höchstform ist und sich sehr gut konzentrieren kann. Wenn Sie das Wohlempfinden Ihres Kindes betrachten und in der Tagesplanung Ihres Kindes völlig frei wären, welche der folgenden Zeiten würden Sie für das Absolvieren der Aufgabe oder des Spiels wählen?
    a. 07:00 – 11:00 Uhr
    b. 11:00 – 15:00 Uhr
    c. 15:00 – 20:00 Uhr

32. Nehmen Sie an, Sie *würden* Ihr Kind zweimal in der Woche in eine sportliche Aktivität schicken (z. B. Schwimmen). Das Einzige was von der Zeit her möglich wäre, ist zweimal in der Woche von 7 bis 8 Uhr morgens. In welcher Verfassung würde Ihr Kind sein?

a. wäre in sehr guter Verfassung

b. wäre in guter Verfassung

c. wäre in mittelmässiger Verfassung

d. wäre in wenig guter Verfassung

e. wäre in nicht guter Verfassung

33. Zu welcher Zeit am Abend scheint Ihr Kind müde zu sein und braucht demnach Schlaf?

a. vor 18:30

b. 18:30 - 19:14

c. 19:15 - 21:29

d. 21:30 - 22:14

e. nach 22:15

34. *Wenn Ihr Kind täglich um 6:00 Uhr aufstehen *müsste*, wie wäre das für Ihr Kind?

a. sehr schwierig

b. eher schwierig

c. mittelmässig schwierig

d. wenig schwierig

e. nicht schwierig

35. *Wenn Ihr Kind immer um __:__ Uhr* ins Bett gehen *müsste*, wie wäre das für Ihr Kind?
(* für 2Jährige: 18:00 Uhr; für 2 bis 4Jährige: 18:30 Uhr; für 4 bis 8Jährige: 19:00 Uhr; für 8 bis 11Jährige: 19:30 Uhr)

a. sehr schwierig

b. eher schwierig

c. mittelmässig schwierig

d. wenig schwierig

e. nicht schwierig

36. Wenn Ihr Kind am Morgen erwacht, wie lange braucht es um hell wach zu werden?

a. 0 Minuten, Sofort

b. 1 bis 4 Minuten

c. 5 bis 10 Minuten

d. 11 bis 20 Minuten

e. ≥ 21 Minuten

Nachdem Sie die oben genannten Fragen beantwortet haben, haben Sie bestimmt ein Gefühl dafür entwickelt, welcher Tagestyp bzw. Chronotyp Ihr Kind ist. Wenn beispielsweise Ihr Kind bevorzugt, an freien Tagen länger zu schlafen als an geregelten Tagen oder, wenn es beispielsweise jeweils am Montagmorgen Mühe hat aus dem Bett zu steigen, so ist Ihr Kind eher ein Abendtyp (genannt „Eule"). Hingegen, wenn Ihr Kind regelmässig (auch an freien Tagen) früh, beispielsweise immer zu Schulzeiten aufwacht, sich wach und munter fühlt, so ist Ihr Kind eher ein Morgentyp (genannt „Lerche"). Bitte schätzen Sie Ihr Kind nach den verschiedenen Tagestypen bzw. Chronotypen ein *(zum jetzigen Zeitpunkt)*.

37. Was trifft für Ihr Kind am ehesten zu?

KIND…	auf jeden Fall einen Morgentyp	eher einen Morgentyp als einen Abendtyp	Mitteltyp (weder noch)	eher einen Abendtyp als einen Morgentyp	auf jeden Fall einen Abendtyp	weiss ich nicht
jetzt	☐	☐	☐	☐	☐	☐

Vielen Dank für das Ausfüllen des Fragebogens!

Children's ChronoType Questionnaire (CCTQ) – englische Version

Demographics: Please answer the following questions or choose the best answer.

Individual completing the questionnaire: ☐ Mother ☐ Father ☐ Other _____

Today's Date: ___ / ___ / ____ (day/month/year) Child's Sex: ☐ Male ☐ Female

Child's Birth Date: ___ / ___ / ____ (day/month/year) Child's Birth Order: _____
Child's Age: ____ years Is he/she an Only Child? ☐ Yes ☐ No

How many children are included in your nuclear family? _____
Do all children in your family have the same biological parents? ☐ Yes ☐ No

Child's current level of education:
☐ Preschool ☐ Kindergarten ☐ Grade _____ ☐ Not attending school
If he/she attends school, how many days/week? _____ How many hours/day? _____

Does he/she go to Day Care or After-School Care? ☐ Yes ☐ No
If yes, how many days/week? _____ How many hours/day? _____

Directions: The following questions ask about sleep/wake patterns during "Scheduled Days" in contrast to "Free Days". Think about your child's behavior during recent weeks when answering these questions. For questions with changing conditions (e.g., child goes to day care at 7:00am 1 day/week and 9:00am 3 days/week), fill in or select the most frequent or common answer.

Scheduled Days

Child's sleep-wake pattern is directly influenced by individual or family activities (e.g., by school, day care, work, athletics etc.)

On Scheduled Days, my child …

1. …wakes up at ____ : ____ am
2. …regularly wakes up:
   ☐ by him/herself ☐ with help from a family member ☐ with an alarm clock
3. …gets up at ____ : ____ am
4. …is fully awake by ____ : ____ am
5. …takes regular naps: ☐ Yes ☐ No
   If yes, he/she naps ___ days/week. If no, why does he/she not nap?
   If yes, he/she sleeps for ___ minutes/nap. _____

On nights before Scheduled Days…

6. …my child goes to bed (body in bed) at ____ : ____ pm
7. …my child is ready to fall asleep (lights turned out) at ____ : ____ pm
8. …it takes him/her ____ minutes to fall asleep (after lights turned out).

Free Days

Child's sleep/wake pattern is "free" from the influence of individual or family activities (e.g., by school, day care, work, athletics etc.)

On Free Days, my child …

9. …normally wakes up at ____ :____ am

10. …wakes at his/her normal time on scheduled days, but then goes back to sleep after waking: ☐ Yes ☐ No If yes, my child goes back to sleep for ____ minutes after waking.

11. …gets up by ____ : ____ am

12. …is fully awake by ____ : ____ am

13. …takes regular naps: ☐ Yes ☐ No
If yes, he/she naps ___ days per week.
If yes, he/she sleeps for ___ minutes per nap.
If no, why does he/she not nap? _____

On nights before Free Days…

14. …my child goes to bed (body in bed) at ____ : ____ pm

15. …my child is ready to fall asleep (lights turned out) at ____ : ____ pm

16. …it takes him/her ____ minutes to fall asleep (after lights turned out).

Directions: For each of the following questions, please select the answer that best describes your child. Make your judgments based on how the behavior of your child was in recent weeks. There are no "right" or "wrong" answers.

17. *If your child has to be awakened, how difficult do you find it to wake your child up in the morning?
a. very difficult b. fairly difficult c. moderate difficult d. slightly difficult
e. not at all difficult/my child has never to be awakened

18. *How alert is your child during the first half hour after having awakened in the morning?
a. not at all alert b. slightly alert c. moderate alert d. fairly alert e. very alert

19. Considering your child's "feeling best" rhythm, at what time would your child **get up** if he/she could decide by him/herself and if he/she were entirely free to plan the day (e.g., vacation)?
a. prior to 6:30 am b. 06:30 - 7:14 am c. 7:15 - 9:29 am d. 9:30 - 10:14 am
e. after 10:15 am

20. Considering your child's "feeling best" rhythm, at what time would your child **go to bed** if he/she could decide by him/herself and if he/she were entirely free to plan the next day (e.g., weekend)?
a. prior to 18:59 pm b. 19:00 - 19:59 pm c. 20:00 - 21:59 pm d. 22:00 - 22:59 pm
e. after 23:00 pm

21. Let's assume that your child has to be at peak performance for a test that will be mentally exhausting for 2 hours. Considering your child's "feeling best" rhythm and that you are entirely free to plan your child's day, which ONE of the three time intervals would you choose for the test?

a. 07:00 – 11:00 am b. 11:00 am – 15:00 pm c. 15:00 – 20:00 pm

22. Let's assume that you have decided to enroll your child in an athletic activity (e.g., swimming). The only class available meets twice a week at 7 to 8 am. How do you think he/she will perform?

a. would be in very good form b. would be in good form c. would be in reasonable form

d. would find it difficult e. would find it very difficult

23. At what time in the evening does your child seem tired and in need of sleep?

a. prior to 18:30 pm b. 18:30 - 19:14 pm c. 19:15 - 21:29 pm d. 21:30 - 22:14 pm

e. after 22:15 pm

24. *If your child had to get up every day at 6 am, what do you think it would that be like for him/her?

a. very difficult b. rather difficult c. moderate difficult

d. a little difficult, but not a great problem e. not at all difficult

25. *If your child always had to go to bed at ___, what do you think it would be like for him/her? (for 2 years old: 06:00 pm; for 2 to 4 years old: 06:30 pm; for 4 to 8 years old: 07:00 pm; for 8 to 11 years old: 07:30 pm)

a. very difficult b. rather difficult c. moderate difficult

d. a little difficult, but not a great problem e. not at all difficult

26. When your child wakes up in the morning, how long does it take to be fully awake?

a. 0 minutes (i.e., immediately) b. 1 to 4 minutes c. 5 to 10 minutes d. 11 to 20 minutes

e. ≥ 21 minutes

Directions: After answering the above questions, you may have a feeling which "Chronotype" or "Time-of-Day type" your child is. For example, if your child would like to sleep quite a bit longer on "Free Days" compared to "Scheduled Days" or if it is difficult for your child to get out of bed on Monday mornings, then he/she is more likely to be an Evening Type person (a "Night Owl"). If your child, however, regularly wakes up and feels perky once he/she gets out of bed, and your child prefers to go to bed rather early than late, then he/she is more likely a Morning Type person (a "Morning Lark"). Please categorize your child using one of the following choices. Please choose only one category!

27. My child is…

☐ Definitely a Morning Type

☐ Rather a Morning Type than an Evening Type

☐ Neither a Morning nor an Evening Type

☐ Rather an Evening Type than a Morning Type

☐ Definitely an Evening Type

. ☐ I do not know

The M/E score is derived by adding points from answers 17-26 (a=1, b=2, c=3, d=4, d=5), except as indicated by *, where point values has to be reversed.

PSI-SF

Parenting Stress Index – Short Form

deutsche Kurzversion nach einer Übersetzung von Sarimski (1993)

Wir bitten Sie, bei den folgenden Sätzen jeweils anzugeben, wie sehr sie mit Ihrem eigenen Gefühl übereinstimmen. Wenn Sie nicht genau die Antwort finden, die zu Ihrem Empfinden passt, geben Sie bitte die an, die ihm am nächsten kommt. Wenn Sie nicht sicher sind, geben Sie bitte eine -3- an. Ihre erste Reaktion auf jede Frage sollte auch jeweils ihr Urteil sein.

1	2	3	4	5
trifft gar nicht zu	trifft nicht zu/wenig	nicht sicher/manchmal	trifft zu/eher	trifft sehr zu

Beispiel:

	Ich gehe gerne ins Kino.	1	2	3	4	5

(wenn Sie hin und wieder gern ins Kino gehen, kreuzen Sie bitte -4- an)

1.	Ich habe oft das Gefühl, dass ich nicht sehr gut mit den Dingen zurechtkomme.	1	2	3	4	5
2.	Ich finde, dass ich mehr von meinem eigenen Leben aufgebe, um den Bedürfnissen meines Kindes gerecht zu werden als ich je dachte.	1	2	3	4	5
3.	Ich fühle mich durch meine Verantwortung als Mutter/Vater wie eingefangen.	1	2	3	4	5
4.	Seit das Kind da ist, konnte ich keine neuen oder anderen Dinge mehr anfangen.	1	2	3	4	5
5.	Seit das Kind da ist, habe ich das Gefühl, ich könne fast nie mehr Dinge tun, die ich gern mache.	1	2	3	4	5
6.	Ich bin unglücklich über die letzten Kleiderkäufe, die ich für mich gemacht habe.	1	2	3	4	5
7.	Es gibt einige Dinge in meinem Leben, die mich bedrücken.	1	2	3	4	5
8.	Ein Kind zu haben, hat mehr Probleme für meine Partnerbeziehung gebracht als ich dachte.	1	2	3	4	5
9.	Ich fühle mich einsam und ohne Freunde.	1	2	3	4	5
10.	Wenn ich zu einem Fest gehe, habe ich gewöhnlich nicht die Erwartung, dass es mir Spass machen wird.	1	2	3	4	5
11.	Ich habe nicht mehr so viel Interesse an anderen Leuten wie früher.	1	2	3	4	5
12.	Ich geniesse bestimmte Dinge nicht mehr so wie früher.	1	2	3	4	5
13.	Mein Kind macht selten etwas für mich, was mir gut tut.	1	2	3	4	5
14.	Manchmal habe ich das Gefühl, mein Kind mag mich nicht und will nicht in meiner Nähe sein.	1	2	3	4	5
15.	Mein Kind lächelt mich weniger an als ich erwartet habe.	1	2	3	4	5
16.	Wenn ich etwas für mein Kind tue, dann habe ich das Gefühl, dass meine Anstrengung gar nicht recht anerkannt wird.	1	2	3	4	5
17.	Beim Spielen lacht oder kichert mein Kind kaum.	1	2	3	4	5
18.	Mein Kind scheint nicht so schnell zu lernen wie andere Kinder.	1	2	3	4	5
19.	Mein Kind scheint nicht so viel zu lächeln wie andere Kinder.	1	2	3	4	5
20.	Mein Kind kann nicht so viele Dinge wie ich erwartet habe.	1	2	3	4	5
21.	Es dauert lange und es ist sehr schwierig für mein Kind, sich an neue Dinge zu gewöhnen.	1	2	3	4	5

Kreuzen Sie bitte bei den Fragen 22., 32. und 33. eine der angegebenen Möglichkeiten an.

22. Ich habe das Gefühl, ich bin
    - eine sehr gute Mutter / ein sehr guter Vater O
    - besser als die/der durchschnittliche Mutter/Vater O
    - eine durchschnittliche Mutter / ein durchschnittlicher Vater O
    - jemand, der einige Schwierigkeiten damit hat, Mutter/Vater zu sein O
    - eine *nicht* sehr gute Mutter / ein *nicht* sehr guter Vater O

23.	Ich habe erwartet, dass ich innigere und positivere Gefühle für mein Kind haben würde und das bedrückt mich.	1	2	3	4	5
24.	Manchmal tut mein Kind Dinge, die mich ärgern, einfach um gemein zu sein.	1	2	3	4	5
25.	Mein Kind scheint mehr zu schreien und zu quengeln als die meisten anderen Kinder.	1	2	3	4	5
26.	Mein Kind wacht in der Regel schlecht gelaunt auf.	1	2	3	4	5
27.	Ich finde mein Kind ist sehr stimmungsschwankend und leicht erregt.	1	2	3	4	5
28.	Mein Kind macht einige Dinge, die mich sehr aufregen.	1	2	3	4	5
29.	Mein Kind reagiert sehr heftig, wenn etwas geschieht, was es nicht mag.	1	2	3	4	5
30.	Mein Kind gerät über die kleinsten Dinge leicht in Aufregung.	1	2	3	4	5
31.	Der Schlaf- und Essrhythmus meines Kindes war viel schwerer aufzubauen als ich dachte.	1	2	3	4	5

32. Ich habe festgestellt, mein Kind zu etwas aufzufordern oder ihm etwas zu untersagen, ist
    - viel schwerer als ich dachte O
    - etwas schwerer als ich dachte O
    - ungefähr so schwer wie ich erwartet habe O
    - etwas leichter als ich dachte O
    - viel leichter als ich dachte O

33. Bitte denken Sie sorgfältig darüber nach, wie viele Dinge es gibt, die Ihr Kind *insgesamt* tut, die sie ärgern (z.B. trödeln, nicht hören, umherjagen, schreien, unterbrechen, schlagen, jammern, etc.). Bitte kreuzen Sie die Zahl an, die bei der Zahl steht, die Sie gezählt haben.

    1-3 O
    4-5 O
    6-7 O
    8-9 O
    10+ O

34.	Es gibt einige Dinge, die mein Kind tut, die mich wirklich sehr ärgern.	1	2	3	4	5
35.	Mein Kind erwies sich als grösseres Problem als ich erwartete.	1	2	3	4	5
36.	Mein Kind stellt mehr Anforderungen an mich als andere Kinder an ihre Eltern.	1	2	3	4	5

Vielen Dank für Ihr Engagement!

Emotionalitäts-Aktivitäts-Soziabilitäts-Temperamentsinventar (EAS) nach Buss und Plomin (1984)

Auf der folgenden Seite finden Sie mehrere Aussagen, wie sich Kinder verhalten können. Einige dieser Aussagen können für das Verhalten Ihres eigenen Kindes charakteristisch sein, andere nicht. Für jede dieser Aussagen bitten wir Sie deshalb einzustufen, wie sehr diese für Ihr Kind charakteristisch ist. Es gibt dabei keine richtigen oder falschen Antworten, da sich alle Menschen verschieden verhalten.

Bei Ihren Antworten achten Sie bitte auf folgende Punkte:

1. Geben Sie nur Antworten, die wirklich das Verhalten Ihres Kindes beschreiben.
2. Verlieren Sie nicht zuviel Zeit beim Überlegen. Gebe Sie die erste spontane Antwort, die Ihnen einfällt. Sicher sind manche Aussagen zu kurz und geben Ihnen nicht alle Informationen, die Sie sich wünschen. Bitte kreuzen Sie unter den gegebenen Umständen die beste Antwort an.
3. Beantworten Sie bitte jede Frage! Achten Sie auch darauf, dass Sie keine Frage überspringen.

Wie *charakteristisch* sind folgende Aussagen?

		nicht	*wenig*	*mittel -mässig*	*eher*	*sehr*
1.	Das Kind neigt zu Schüchternheit.	☐	☐	☐	☐	☐
2.	Das Kind fängt leicht an zu weinen.	☐	☐	☐	☐	☐
3.	Das Kind ist gerne unter Menschen.	☐	☐	☐	☐	☐
4.	Das Kind ist immer in Bewegung.	☐	☐	☐	☐	☐
5.	Das Kind spielt lieber mit anderen als alleine.	☐	☐	☐	☐	☐
6.	Das Kind neigt dazu, emotional zu sein.	☐	☐	☐	☐	☐
7.	Wenn sich das Kind umherbewegt, tut es dies gewöhnlich langsam.	☐	☐	☐	☐	☐
8.	Das Kind findet leicht Freunde.	☐	☐	☐	☐	☐
9.	Das Kind springt auf und läuft herum, sobald es morgens aufwacht.	☐	☐	☐	☐	☐
10.	Das Kind findet Menschen anregender als alles andere.	☐	☐	☐	☐	☐
11.	Das Kind quengelt und weint oft.	☐	☐	☐	☐	☐
12.	Das Kind ist sehr kontaktfreudig.	☐	☐	☐	☐	☐
13.	Das Kind steckt voller Tatendrang.	☐	☐	☐	☐	☐
14.	Das Kind braucht lange, um mit Fremden warm zu werden.	☐	☐	☐	☐	☐
15.	Das Kind regt sich leicht auf.	☐	☐	☐	☐	☐
16.	Das Kind ist eher ein Einzelgänger.	☐	☐	☐	☐	☐
17.	Das Kind bevorzugt ruhige, weniger aktive Spiele gegenüber aktiveren Spielen.	☐	☐	☐	☐	☐
18.	Wenn das Kind allein ist, fühlt es sich ausgeschlossen.	☐	☐	☐	☐	☐
19.	Das Kind reagiert intensiv, wenn es sich aufregt.	☐	☐	☐	☐	☐
20.	Das Kind ist Fremden gegenüber sehr freundlich.	☐	☐	☐	☐	☐

Kritische Lebensereignisse

In der Folge finden Sie eine Liste von bedeutsamen Lebensereignissen. Bitte geben Sie an, ob **in den letzten 12 Monaten** eines der folgenden Ereignisse in Ihrer Familie stattgefunden hat (ja/nein). Falls eines dieser Ereignisse statt gefunden hat, geben Sie zusätzlich an, wie belastend dieses Ereignis für Sie war.

1.	Eigene Schwangerschaft oder Geburt	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
2.	Eigene Trennung oder Scheidung	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
3.	Eigene Heirat/Wiederverheiratung	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
4.	Heftiger und andauernder Streit mit Partner oder anderen Familienmitgliedern	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
5.	Zuzug einer verwandten oder bekannten Person in den eigenen Haushalt	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
6.	Wegzug eines bedeutsamen Anderen	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
7.	Inhaftierung eines Familienmitgliedes	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
8..	Deutliche Veränderung des Familieneinkommens	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark
9.	Ernsthafte Verschuldung	☐ ja ☐ nein Wie stark belastend war dies für Sie? ☐ nicht belastend sehr leicht ① ② ③ ④ ⑤ sehr stark

10. Umzug/Wohnortswechsel ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

11. Eigener Stellenwechsel oder Stellenwechsel des Ehepartners ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

12. Eigene Arbeitslosigkeit oder Arbeitslosigkeit des Ehepartners ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

13. Ernsthafte Krankheit oder schwerer Unfall eines Familienmitgliedes (ausser Ihres Kindes) ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

14. Todesfall in der Familie oder im engeren Bekanntenkreis ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

15. Schulwechsel/Schulverweis eines Ihrer Kinder ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

16. Gravierendes Misserfolgserlebnis (z.B. nicht Bestehen einer Prüfung) ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

17. Verlust eines Haustieres ☐ ja ☐ nein
Wie stark belastend war dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

18. Gibt es sonst zurzeit irgendwelche belastende Lebensumstände?
☐ ja ☐ nein

Wie stark belastend ist dies für Sie?
☐ nicht belastend
sehr leicht ① ② ③ ④ ⑤ sehr stark

Vielen Dank für das Ausfüllen des Fragebogens!

Fragebogen zum Chronotypus (MCTQ, Roenneberg, 2002)

Dieser Fragebogen erfasst allgemeine Informationen und fragt auf einfache Weise nach den Zeiten, wann Sie schlafen gehen und wann Sie aufwachen bzw. aufstehen. Dabei ist es wichtig zwischen Arbeitstagen und freien Tagen zu unterscheiden. Arbeitstage werden definiert als Tage, an denen Ihr Schlaf-Wach-Rhythmus *direkt* durch arbeitsbezogene oder familiäre Aktivitäten beeinflusst wird. Freie Tage hingegen werden definiert als Tage, an denen der Schlaf-Wach-Rhythmus nicht durch solche Aktivitäten beeinflusst wird (z.B. Ferientage).

Bitte geben Sie folgende Informationen an:

Geburtsdatum:	
Alter in Jahre:	
heutiges Datum:	
Geschlecht:	
Name:	

I. Schlafverhalten

An Arbeitstagen (geregelten Tagen)…

stehe ich um…	_____ Uhr auf
erwache ich regelmässig…	☐ vor dem Wecker
	☐ mit dem Wecker
	Mein Wecker klingelt um _____ Uhr
brauche ich…	_____ Min. um wach zu werden
ab…	___ : ___ Uhr bin ich dann hell wach und voll einsatzfähig
gegen…	_____ Uhr habe ich einen Tiefpunkt (Leistungsabfall wegen Müdigkeit)
gegen…	_____ Uhr habe ich normalerweise einen Hungerrast
vor Arbeitstagen gehe ich gegen…	_____ Uhr ins Bett
und brauche dann…	_____ Min. um einzuschlafen
nach dem Ins-Bett-Gehen möchte ich noch lesen…	☐ stimmt ☐ stimmt nicht
	wenn stimmt:
	und lese dann noch für…_____ Min
schaffe aber meist nicht mehr als…	_____ Min. bevor ich einschlafe
wenn ich die Gelegenheit dazu habe, dann halte ich gerne	☐ stimmt - und schlafe dann für…
einen Mittagsschlaf…	_____ Min.
	☐ stimmt nicht
an Arbeitstagen halte ich mich durchschnittlich	_____ h _____ min. draussen im Tageslicht
pro Tag…	(wirklich im Freien!) auf

An freien Tagen (bitte nur Angaben über normale freie Tage, ohne Parties etc.)…

würde ich am liebsten bis…	_____ Uhr schlafen
wache ich meist um…	_____ Uhr auf
	zur gleichen Zeit wie der Wecker an Arbeitstagen klingeln würde
	☐ ja ☐ nein
stehe ich normalerweise um…	_____ Uhr auf
brauche ich…	_____ Min. um wach zu werden
ab…	___ : ___ Uhr bin ich dann hell wach und voll einsatzfähig
gegen…	_____ Uhr habe ich einen Tiefpunkt (Leistungsabfall wegen Müdigkeit)
gegen…	_____ Uhr habe ich normalerweise einen Hungerrast
vor freien Tagen gehe ich gegen…	_____ Uhr ins Bett
und brauche dann…	_____ Min. um einzuschlafen

nach dem Ins-Bett-Gehen möchte ich noch lesen…	☐ stimmt ☐ stimmt nicht *wenn stimmt*: und lese dann noch für…_____ Min
schaffe aber meist nicht mehr als…	_____ Min. bevor ich einschlafe
wenn ich die Gelegenheit dazu habe, dann halte ich gerne einen Mittagsschlaf…	☐ stimmt - und schlafe dann für… _____ Min. ☐ stimmt nicht
an freien Tagen halte ich mich durchschnittlich pro Tag…	_____ h _____ min. draussen im Tageslicht (wirklich im Freien!) auf

II. Einschätzung des eigenen Chronotypen

Nachdem Sie die oben genannten Fragen beantwortet haben, haben Sie bestimmt ein Gefühl dafür entwickelt, welcher Tagestyp bzw. Chronotyp Sie sind. Wenn Sie beispielsweise bevorzugen, an freien Tagen länger zu schlafen als an geregelten Tagen oder, wenn Sie beispielsweise jeweils am Montagmorgen Mühe haben aus dem Bett zu steigen, so sind Sie eher ein Abendtyp (genannt „Eule"). Hingegen, wenn Sie regelmässig (auch an freien Tagen) früh, beispielsweise immer um 6 Uhr aufwachen, sich wach und munter fühlen, so sind Sie eher ein Morgentyp (genannt „Lerche"). Bitte schätzen Sie sich selbst nach den verschiedenen Tagestypen bzw. Chronotypen ein *(zum jetzigen Zeitpunkt und als Teenager)*.

38. Was trifft für Sie am ehesten zu?

	auf jeden Fall einen Morgentyp	eher einen Morgentyp als einen Abendtyp	Mitteltyp (weder noch)	eher einen Abendtyp als einen Morgentyp	auf jeden Fall einen Abendtyp	weiss ich nicht
jetzt	☐	☐	☐	☐	☐	☐
als Teenager	☐	☐	☐	☐	☐	☐

Vielen Dank für das Ausfüllen des Fragebogens!

Acknowledgments

I would like to thank PD Dr. med. Oskar Jenni and Prof. Dr. med. Hans-Joachim Haug for mentoring me and supporting my work on this thesis.

A special thank goes to Dr. Luciano Molinari for the stimulating discussions and statistical advice.

I also thank Dr. Monique LeBourgeois for many discussions about the topic and her support.

My further thank goes to all families and children who participated in the studies.

And last but not least, I want to express my gratitude to my colleagues, friends and family.

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